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Mathematics for Production and War*

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THE ADVENT of the present war and its consequent demand for greatly accelerated production of the materials of peace and war has forcefully redirected many elements of the thinking of the American people. The highly technical character of the warfare and the complicated structure of the implements used have combined to create an urgent, if not emergency, demand for speedy, thorough, and widespread training in the fundamental mathematics which is basic in the construction and use of practically every tool of modern warfare. Young men entering any branch of armed service find that mastery of some mathematics is absolutely necessary for any work that is given them, and their usefulness in the service is directly proportional to the extent of their skill in the use of mathematics. Men and women with employment in the war industries are likewise confronted with the necessity of using this subject, at least through trigonometry, in almost any task that is assigned to them. Boys and girls looking to service either in the war industries or with the armed forces are advised that any proper preparation for such service must include mastery of as many basic mathematical skills as possible. These war symptoms have combined to create a type of stampede to mathematics courses, wherever they are offered. The elementary and secondary schools are experiencing unprecedented enrollments in mathematics classes. Colleges are finding that decreased general enrollments are more than offset by unusually heavy enrollments in such courses. The extension divisions, correspondence schools, vocational schools, and the various government sponsored training programs such as the college level ESMWT programs are conducting many well-filled classes in mathematics. It is hardly necessary to say that many quack programs of mathematical instruction with grandiose claims as to ease and speed of learning have sprung up.

We are all aware of the situation that I have just described, and we agree that there is urgent need for an extensive program of mathematical instruction in the schools. I should like to say that the war demands have been symptomatic of this need, but that they are not to be regarded as the basic cause of it. I would regard it as most unfortunate if the program of mathematical instruction conducted in our school system at this time was designed for the sole purpose of meeting or curing these war symptoms. It is clear to me that the same mathematics that is needed to build ships, airplanes, tanks, trucks, and guns for war purposes is also needed to build

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ships, airplanes, tractors, trucks, and precision instruments for peacetime use. The same mathematical skills that are needed to navigate a warplane or ship, to forecast weather conditions for warfare, or to operate any one of the many precision instruments of war are also needed in the peacetime counterpart of these activities. Even while the war program is on, there are a multitude of peace-time activities adjusted and expanded to meet war needs and in which considerable mathematical skil is necessary. Price control, point rationing, priorities, and many other recent innovations in our daily life are handled only through the use of much mathematics. These activities are developments of their peacetime counterparts and will continue when the war has been won. I would urge that we regard the demand for substantial expansion in mathematical instruction as one which is not strictly a wartime need, but rather look at it as something which will continue after the war. With this in mind then, changes in school courses to meet the war demands should be made with full consideration of their roles in the long range, peace-time development of the school curriculum.

As school principals and teachers, you are concerned with two major questions: What mathematics should be taught in the schools, and how can this be taught most effectively in view of the fact that existing school facilities and faculties must be used in-so-far as this is at all possible. These same questions confront the universities and colleges and it is my hope that my few remarks will offer some useful suggestions toward their solution. Through many contacts with the armed services—both in an advisory capacity and as an observer, and through rather intimate contact with a variety of the war industries as organizer and supervisor of several hundred mathematics courses for the workers in these industries, I have attempted to determine the mathematics that is needed for these activities. Our California Sub-committee on Mathematics has investigated this problem during the past year and is submitting a report on its conclusions to the California Committee for the Study of Education this afternoon. Many national committees have studied the problem and their reports are now finding publication in journals. I mention a few of these:

1. U. S. Office of Education and National Council of Teachers of Mathematics Committee (President Rolland R. Smith of N.C.T.M., Chairman). "Pre-induction Courses in Mathematics," THE MATHEMATICS TEACHER, March, 1943. Pages 114–124.
2. Report of the Cooperative Committee on Science Teaching (American Association of Physics Teachers, American Chemical Society, Mathematical Association of America, Union of American Biological Societies, National Association for Research in Science Teaching. Robert J. Havighurst, Chairman). "High School Science and Mathematics in Relation to the Manpower Problem," *School Science and Mathematics*, February, 1943. (Pages 126–156).
3. State of Indiana, Department of Public Instruction. "The Indiana Plan for Emergency Mathematics in High Schools." Dr. Clement T. Malan, State Superintendent of Public Instruction. December, 1942.
4. National Council of Chief State School Officers. "A Wartime Program in Mathematics and Physics," and supplement "50 Typical Problems in Mathematics and Physics." May, 1942. Obtainable through Paul Eddy, Editor of Publications, Florida State Department of Education, Tallahassee, Florida.
5. Report of the Sub-committee on Education for Service of the American Mathematical Society and the Mathematical Association of America. (W. L. Hart, Chairman). American Mathematical Monthly, June-July, 1941. Pages 353–362.

All of these studies lead to one general conclusion: Namely, that the same basic arithmetic, algebra, geometry, and trigonometry is needed for boys and girls, whether destined for service with the armed forces, with the war industries, or on the home front. The most urgent need is for a thorough understanding of arithmetic and this means real skill in adding, subtracting, multiplying, and dividing whole numbers. It means ability to work with common and decimal fractions, percentages, ratios, square roots, and mensuration. It is perhaps interesting to observe here that the basic course in mathe-

matics given to prospective pilots, bombardiers, and navigators in the Army Air Corps begins with operations on whole numbers and includes the algebraic method of extracting the square root. For the war industries, our greatest demand is for courses that develop arithmetic skill and accuracy on the part of the workers. An aircraft plant in this area manufactures aircraft parts from plywood and a large portion of its employees are former carpenters, cabinet makers, furniture workers, etc. These people know how to work with glue, and can saw boards from which neat joints can be made—at least with a little "drawing up" to correct errors. However, their work on airplane parts demands accuracy expressed in small decimals, and the "drawing up" operation is not permissible. Few of these people ever heard of decimal fractions and certainly fewer could work effectively with them. We have given courses designed to correct this. Next to the need for arithmetic fundamentals, comes the need for algebraic fundamentals —at least through quadratic equations. In reality, this work should be regarded as further work with arithmetic. Here, the important thing is to learn to use formulas correctly and to change the form of these formulas so that any one of the unknown quantities can be found from the given data. Geometry—plane and solid—is important for the geometric facts and constructions given and for the development of space concepts. We are fighting a three dimensional war, and any small portion of battle strategy must be planned as a space manuever. Our airplanes are built from blueprints which must be developed into solid objects. Each worker in an aircraft plant must be able to visualize his portion of the plane as a functioning part of the three dimensional whole airplane. Geometric relations and constructions enter into the building of every piece of a modern machine. Regular polygons, tangent circles, triangles, and now the conic sections are helping to build airplanes whose excellent performance is smothering the axis. Trigonometry is important—particularly the numerical aspects of it. I estimate that 75% of the employees of an aircraft plant make some use of trigonometry during the course of any day. I do not mean to say that this percentage of the people have had a formal course in trigonometry. I wish they had for much time and labor could then be saved in checking their work before the planes are delivered. For the armed service, plane and spherical trigonometry enter into the calculations that precede the firing of practically all guns, form the basis for all navigation, help locate enemy targets and aircraft, and play key roles in all manuevers. I shall not discuss the wartime roles played by college level courses in mathematics since these, although extremely important and conspicuous, do not constitute a major concern for the majority of the people here present.

The point that I wish to make here is that the secondary school needs for mathematical instruction in connection with production and warfare can be met for all students without the necessity of organizing a large number of new courses. In all activities, the same basic portions of existing courses are needed. I do think that existing courses in arithmetic, algebra, geometry, and trigonometry need some redistribution of emphasis. They certainly need to be filled with applications to a variety of present day problems. I urge, then, that schools make no attempt to set up separate courses such as "Mathematics for Aviation Shop Workers," "Mathematics for Nurses," "Mathematics of Radio," "Mathematics for Navigation," and scores of other similar titles directed at specific applications of mathematics. Rather, I urge that existing standard courses in arithmetic, algebra, geometry, and trigonometry be used for all students whose performance and aptitude indicate their ability to take them. These courses should place more emphasis on applications and the applications should be chosen from a variety of fields. I would

urge that each principle given be illustrated by problems taken from industry, problems from the armed services, and problems from home front activities. In this way, any student will see that the principle is capable of broad application and will call on it whenever he needs it even though his problem may arise in a strange setting. If the problems are well-planned by a wide-awake teacher, a student will be as interested in one taken from any one of the fields as he would be in one from the field toward which he is headed. Wherever possible then, students should follow the usual sequence of mathematics courses and teachers should make a special effort to see that these courses are made thoroughly functional through redistribution of emphasis and through the use of many highly practical illustrations.

Some students are too close to actual entry into war service to get maximal profit from the usual sequence of courses. As indicated before, the order of importance for the mathematical material is arithmetic, algebra, geometry, and trigonometry. To take care of the students just mentioned, a school should attempt to organize a combined course which starts with arithmetic and proceeds as far as possible into the other subjects—not leaving one subject, however, until this has been sufficiently mastered to give skill and accuracy in its use. It is believed that a school would not need to organize more than two such special courses (one extending over two semesters, while the other is a one semester course) and that the need for these will disappear as quickly as students adjust themselves to taking mathematics through the grammar school and early high school grades. These courses should not be available to students who have time to take the regular sequence of courses. They should be taught by experienced mathematics teachers.

On the matter of counseling. Every student, male or female, should be counseled to take as much mathematics as his abilities permit. He should be urged to go as far in the sequence of courses indicated as possible to maintain satisfactory performance. He should not be permitted to enter the special combined courses if his available high school time permits him to follow the regular sequence for as much as one year.

On the question of teachers for the mathematics courses, first let me say that I regard it as an urgent responsibility of every mathematics teacher to devote a great amount of effort to learning the uses of his subject in all phases of our present day activity. He must find these applications by his own efforts—no agency is going to supply them to him in "well done up" packages. He must master them well in order that his courses be so filled with up-to-the-minute applications that every student in his class will know that the fundamental mathematical principles learned are indispensable tools for him. If the teacher does this, then he has justified the preferred place that his subject has in the wartime curriculum and justified his own preferred classification as an essential war worker. He has also done much to preserve a place for his subject in the school curriculum for the peacetime years that lie ahead. These regular mathematics teachers should be used to capacity, of course. They should be discouraged from leaving their positions for industrial jobs, or for enlistment in the armed services. Selective service has recognized their function as essential to the war program. They should continue to do this essential job with the full support of their school administration in seeking deferred classification under selective service. Even with the regular mathematics staff preserved, there will still be a teacher shortage. Budgetary limitations make it imperative that this be met in so far as possible through use of teachers in other departments who hold tenure in the school system. It is my personal opinion that good teachers in any department who have had the mathematical subject matter to be taught, and

who have enthusiasm for the undertaking, can be made into highly satisfactory mathematics teachers. The regular teachers of mathematics can conduct refresher courses for their colleagues in other departments. These courses should review the subject matter of the courses to be taught, and should emphasize teaching techniques peculiar to the mathematics courses. A careful distribution of the classes to be taught between these refreshed teachers along with extra supervisory and coordination work on the part of the regular mathematics faculty will do much to meet the teacher shortage. It is perhaps worthwhile to suggest that ESMWT has a free correspondence course designed as a refresher for teachers who are now asked to teach mathematics classes for the first time. Doubtless, summer session courses for this same purpose will be conducted by large school systems and by colleges.

I close my remarks with the summarizing statement that the same basic mathematical principles and skills are needed for boys and girls who are to serve with the armed forces, with the war industries, or with any one of the many home front activities that must go on in peacetime as well as wartime. I urge that these needs be met largely through use of existing standard mathematics courses which have been vitalized through some variation of emphasis—particularly with regard to the inclusion of many and varied illustrations to present day problems. When this cannot be done because of time limitations, special combined courses should be offered covering as much of basic arithmetic, algebra through quadratics, geometry, and trigonometry as can be done well in the time allotted. Such combined courses should be taught by excellent and experienced mathematics teachers. It is not recommended that special mathematics courses pointed to single fields of application be organized. It is urged that all children be counseled to take as much mathematics as is at all compatible with their abilities. If such a program is followed, it is my conviction that the secondary schools will render their maximal service to the war program in all of its phases —at least in so far as mathematical instruction is concerned. They will also set and follow a sound curriculum principle that will be indispensable in the years that follow the successful conclusion of the war.

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Some Phases of the Mathematics Testing Program at The Iowa State College

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1. History. The present testing program in mathematics at The Iowa State College was started in 1927. The tests were used in the selection of candidates for the Edison Scholarship Examinations in 1929 and 1930. In 1932 the Iowa Placement Examinations, series MT 2, Revised were used.

The retention, or T-test and its revisions were made by members of the mathematics staff. It originally consisted of four parts, namely, an algebraic, a geometric, a multiple choice and a true-false part. As far as could be determined no essential information not obtained from the other parts of the test was obtained from the true-false section. It has been omitted from the later forms of the test.

The test is given to entering freshmen students in mathematics during the third recitation period in the fall quarter, all sections taking the test in one day. The test is divided into two equivalent forms labeled A and B, for convenience. One form has been used for sections meeting in the morning and the other for sections meeting in the afternoon. The normal testing procedure in administering the test is followed very closely.

The test papers are scored objectively by committees composed of members of the mathematics staff. These committees exercise great care to score the tests uniformly.

The first and third parts of the test are scored 0—1—2 and the second, or multiple choice, is scored 0—1. The score 0 means the question was answered incorrectly or not at all, the score 1 (the integer one) means some elements of the question were answered correctly, while the score 2 means the question was answered correctly. Under this method of scoring the maximum total score obtainable on the test is 100 distributed as follows: Part I, 40; Part II, 20; Part III, 40.

From time to time the order of the questions on each part of the test has been changed according to the degree of success attained by the students on the test given the preceding year. The so-called easier questions or rather the ones on which greater success was attained are placed at the top of the list while the so-called more difficult questions are placed further down the list.

During the freshman days, in the fall, each entering freshman student is given a psychological examination (The A.C.E. test has been used for several years) which in this report will be designated by A. Those students taking College Algebra are given the T or retention test previously described during the third recitation period and are given the D or departmental test during the tenth recitation period. The D-test covers the material taught in class the previous nine days. The results of these three tests are weighted and a composite, or G-score, obtained by linear, multiple regression methods, is given for each individual. The formula used to obtain the G-score for the 1941 test is

$$G = 0.031T + 0.039A + 0.067D - 0.664.$$

The values of G corresponding to values of T, A, and D were readily obtained from a nomographic chart. One year the scores on the G-test were used to resection the groups on the basis of ability as evidenced by the test. The confusion in the resectioning process was very undesirable. Some years a high section for students showing superior ability has been formed. A low section for students showing little ability has been formed at each hour the class meets since the program was initiated with

the exception of the fall 1941 when instructors for these sections were not available.

2. SUCCESSES F 1941. The following tables show the retention, or T-test and the successes and failures of the 704 individuals who took this test in the fall of 1941. The number of the question is given in the first column and the question in the second column. The number of correct answers on each question is entered in the column headed F.C. (full credit) and the corresponding percentage in the next column headed %. Similarly for the headings P.C. (part credit); N.C. (no credit) and N.A. (no answer). Due to the labor involved in assembling the data the survey was limited to the 213 papers submitted by the individuals who took the test at the 8 o'clock hour.

THIS IS THE MATHEMATICS PLACEMENT TEST, 1940–41, A.

PART ONE A

(Fifteen Minutes)

DIRECTIONS: Place the answer to each question on the line at the right.

	F.C.	%	P.C.	%	N.C.	%	N.A.	%
SAMPLE: Multiply: $x-a$ by x. Ans. x^2-ax								
1. Find the product of x^3-x-5 by $2x^2$	201	94.4	8	3.7	3	1.4	1	0.5
2. Add: $2b+3a$ to $2a-4b$.	196	92.0	10	4.7	6	2.8	1	0.5
3. Multiply: $3a-2x$ by $3a+2x$.	193	90.5	9	4.3	10	4.7	1	0.5
4. Divide: $\frac{4}{5}$ by $\frac{2}{7}$.	179	84.0	1	0.5	27	12.7	6	2.8
5. What is the value of $2^x x^3$ if $x=2$?	160	75.1	0	0.0	45	21.2	8	3.7
6. Divide: $15b^4-10a^4b^3$ by $-5b^4$.	48	22.6	94	44.1	49	23.0	22	10.3
7. Subtract: $5b-2x$ from $2b+x$.	160	75.1	20	9.4	32	15.0	1	0.5
8. Given $A=P(1+K)^2$. Find A for $K=0.2$ and $P=100$.	128	60.0	12	5.6	65	30.7	8	3.7
9. Multiply: $2\frac{1}{4}$ by $3\frac{3}{4}$.	127	59.6	25	11.7	55	25.9	6	2.8
10. Divide $3-2b^2$ by $\frac{1}{b^2}$.	143	67.1	12	5.6	20	9.4	38	17.9
11. Factor: $3y^2-7y+2$.	190	89.2	2	1.0	13	6.1	8	3.7
12. Perform the indicated addition: $\frac{2}{y}+\frac{3}{x}$.	132	62.0	15	7.0	47	22.1	19	8.9
13. What is the square root of $4x^2-12xy+9y^2$?	157	73.7	29	13.6	13	6.1	14	6.6
14. If we increase each side of a square by 3 feet, we shall increase the area by 57 sq. feet. Find a side of the original square.	45	21.2	3	1.4	47	22.1	118	55.3
15. Factor: x^3-8.	132	62.0	20	9.4	32	15.0	29	13.6
16. Solve for x in terms of a and b: $ax=2+bx$.	94	44.0	10	4.7	44	20.6	65	30.7
17. Multiply: $\left(3x^2-\frac{1}{x}\right)$ by $2x^2$.	99	46.5	11	5.2	22	10.3	81	38.0
18. Factor: $2ay+ax-2b-bx$.	101	47.4	42	19.7	16	7.5	54	25.4
19. What per cent of five is one-fourth?	74	34.8	2	1.0	48	22.6	89	41.6
20. One man can do a piece of work in nine days, another can do the same work in 6 days. How long will it take both men to do the work if they work together?	35	16.5	6	2.8	42	19.7	130	61.0

PART TWO A

(Eight Minutes)

DIRECTIONS: In each of the following statements enclose that part in the parenthesis which makes the statement correct.

SAMPLE: In the quantity $6xy^4$, 6 is a (coefficient, exponent, index).

	F.C.	%	N.C.	%	N.A.	%
1. 4 multiplied by 0 is (4, 1, 0).	198	93.0	14	6.5	1	0.5
2. The parts of an expression which are connected by plus and minus signs are called (factors, terms, coefficients, exponents).	184	86.4	26	12.2	3	1.4
3. The equation $2x+5=1$ is (fractional, linear, exponential, quadratic).	173	81.2	37	17.4	3	1.4
4. $2^0=$ (1, 0, 2).	117	55.0	93	43.6	3	1.4
5. The equations $x+3y=8$ and $2x-y=2$ are simultaneously satisfied by the values ($x=3$ and $y=4$; $x=6$ and $y=3$; $x=2$ and $y=2$).	186	87.3	11	5.2	16	7.5

	F.C.	%	N.C.	%	N.A.	%
6. The number $2\sqrt{8}$ is (integral, irrational, imaginary, rational).	92	43.2	109	51.2	12	5.6
7. The expression x^2+2x-1 is (quadratic, linear, a constant, a cubic).	156	73.4	51	23.9	6	2.8
8. If two straight lines intersect, the adjacent angles are always (equal, complementary, supplementary).	121	57.8	88	41.3	4	1.9
9. $(25)^{-1/2}$ equals $\left(5, \frac{1}{5}, -\frac{25}{2}\right)$.	78	36.6	117	54.9	18	8.5
10. The equation $\sqrt{x+25}-\sqrt{x+16}=1$ is satisfied if x equals (0, 5, 4, 9).	146	68.6	47	21.0	20	9.4
11. The number 12 is (even, odd, prime).	203	95.3	8	3.7	2	1.0
12. The square of $x-2$ is (x^2-4, x^2-4x-4, x^2-4x+2).	187	87.8	25	11.7	1	0.5
13. The least common multiple of 8, 10, 20 is (2, 20, 40, 80).	95	44.6	114	53.5	4	1.9
14. The surface of a sphere of radius a is (πa^2, $\frac{4}{3}\pi a^3$, $4\pi a^2$).	81	38.0	101	47.4	31	14.6
15. The sum of the interior angles of a pentagon is (4, 6, 8, 10) right angles.	50	23.4	129	60.6	34	16.0
16. The graph of $2x+y=0$ is (parallel to the x-axis, does not cross the y-axis, passes through the origin).	90	42.3	43	20.1	80	37.6
17. The number $\sqrt{-9}$ is (real, imaginary, negative, rational).	138	64.8	41	19.2	34	16.0
18. One root of $x^2+2x+a=0$ is -2 if $a=$ (2, 0, -1, 4).	58	27.2	61	28.7	94	44.1
19. The relation $a(b+c)=ab+ac$ implies the (distributive, associative, communitative law).	36	16.9	85	39.9	92	43.2
20. The roots of $6x-1-2x^2=0$ are (imaginary, equal, irrational).	60	28.2	47	22.1	106	49.7

PART THREE A

(Twenty Minutes)

DIRECTIONS: Place the answer to each question on the line at the right.

SAMPLE: Solve $x^2-9=0$. Ans. $x=\pm 3$

	F.C.	%	P.C.	%	N.C.	%	N.A.	%
1. Write with fractional exponents $\sqrt{2a^2}$.	25	11.7	40	18.8	90	42.3	58	27.2
2. Simplify: $\sqrt{18}$.	152	71.4	7	3.3	38	17.9	16	7.5
3. What value of x makes $2^{x+1}=16$?	159	74.7	0	0.0	46	21.6	8	3.7
4. Simplify: $(\sqrt{3})^4$.	130	61.0	0	0.0	49	23.0	34	16.0
5. Divide: $3a^{3/4}$ by $a^{1/4}$.	80	37.6	12	5.6	78	36.6	43	20.2
6. Two numbers are in the ratio 2:5 and their sum is 21. Find the two numbers.	136	63.9	5	2.3	25	11.7	47	22.1
7. Solve: $x^2+x-6=0$.	103	48.4	67	31.4	19	8.9	24	11.3
8. Multiply: $6x^{-4}$ by $2x^2$.	126	59.1	13	6.1	47	22.1	27	12.7
9. Simplify: $\sqrt{\frac{2}{3}}$.	90	42.3	5	2.3	63	29.6	55	25.8
10. Find the highest common factor of x^2-4, $2x+4$ and $a(x+2)$.	144	67.6	3	1.4	59	27.7	7	3.3
11. Solve for x: $\frac{6x+2}{x-3}+\frac{8}{x-3}=8$.	105	49.3	2	1.0	51	23.9	55	25.8
12. The area of a rectangle is 800 sq. ft., and one side is twice the other. If x represents the shorter side of the rectangle, write an equation to determine x.	135	63.4	10	4.7	40	18.8	28	13.1
13. The wheels of a car are 24 inches in diameter. How far does the car travel if the wheels make five revolutions?	81	38.0	13	6.1	85	39.9	34	16.0
14. Mr. A can do a piece of work in four days; Mr. B can do it in five days. They work together two days and Mr. A quits. How long will it take Mr. B. to finish the work?	27	12.7	3	1.4	52	24.4	131	61.5
15. Factor: $m^2-x^2+4cx-4c^2$.	27	12.7	22	10.3	117	54.9	47	22.1
16. If a marble rolls 3 yards in c minutes, how many feet will it roll in x seconds?	6	2.8	21	9.9	79	37.0	107	50.3
17. Solve (two values of y): $2y^4=5y$.	19	8.9	18	8.5	39	18.3	137	64.3
18. Simplify by rationalizing the denominator $\frac{1}{\sqrt{3}+\sqrt{2}}$.	39	18.3	7	3.3	63	29.6	104	48.8
19. Solve for simultaneous values: $y=9x^2$ and $y=3x$.	2	1.0	16	7.5	45	21.1	150	70.4
20. The altitude of an equilateral triangle is a. What is the length of the side?	2	1.0	7	3.3	72	33.8	132	62.0

3. Standardization of Test, Fall Quarter 1941. The following frequency tables were prepared from the results of the T-test given to the 704 entering freshmen in the month of September in the year 1941.

These frequency tables are for parts I, II, III and for the total.

1. Frequency tables for *T*-test

Part I		Part II		Part III		Total		Total (Cont.)	
Score	Frequency	Score	Frequency	Score	Frequency	Score	Frequency	Score	Frequency
1	0	1	0	0	1	14	1	57	18
2	0	2	3	1	1	15	2	58	16
3	0	3	1	2	6	16	0	59	10
4	0	4	7	3	6	17	0	60	19
5	0	5	16	4	14	18	3	61	13
6	1	6	27	5	11	19	2	62	20
7	2	7	45	6	20	20	5	63	10
8	3	8	57	7	13	21	2	64	13
9	5	9	61	8	14	22	1	65	12
10	5	10	73	9	27	23	7	66	11
11	8	11	81	10	30	24	6	67	12
12	7	12	52	11	20	25	1	68	15
13	9	13	62	12	21	26	1	69	11
14	17	14	59	13	32	27	6	70	14
15	12	15	45	14	38	28	9	71	9
16	11	16	46	15	34	29	3	72	8
17	11	17	25	16	26	30	8	73	10
18	23	18	17	17	34	31	6	74	10
19	17	19	13	18	32	32	10	75	7
20	23	20	4	19	30	33	10	76	14
21	36			20	31	34	5	77	14
22	25			21	28	35	3	78	6
23	30			22	22	36	9	79	5
24	33			23	31	37	7	80	9
25	38			24	24	38	16	81	9
26	42			25	22	39	9	82	3
27	29			26	20	40	12	83	4
28	35			27	19	41	5	84	6
29	32			28	13	42	13	85	3
30	34			29	12	43	11	86	5
31	30			30	19	44	11	87	1
32	32			31	8	45	15	88	7
33	33			32	13	46	12	89	5
34	26			33	6	47	20	90	3
35	27			34	5	48	15	91	1
36	20			35	5	49	13	92	2
37	18			36	7	50	20	93	4
38	12			37	6	51	15	94	0
39	12			38	2	52	12	95	0
40	5			39	0	53	15	96	1
				40	1	54	3	97	0
						55	17	98	0
						56	22	99	0
								100	1*

* This is the first instance in which an individual obtained a perfect score on the T-test.

Some common statistical measures for the 704 papers received in the fall of 1941 which have been computed are:

Quartiles		Deciles	
1.	43.3	1.	31.7
2.	55.5	2.	39.7
3.	67.6	3.	45.9
		4.	50.2
Average	55.7	5.	55.5
Median	55.5	6.	59.8
		7.	64.9
		8.	70.7
Standard Deviation	17.8	9.	78.1

Correlation with Grade attained in Algebra Course 0.60.

4. Types of Errors. The classification of types of errors made on the papers was very difficult. After some study it was decided to classify the errors into ten types. A student on an NYA assignment, Mr. Earl W. Kasdorf, undertook the task of making a frequency table of these errors. As the work involved much labor this

table was limited to the group numbering 213 which took the test at 8 o'clock. The following table is formed for the three parts of the test and the total. The numbers give the frequency of occurrence of the types of errors, in each part of the test and the total.

	I	II	III	Total
Definitions	23	614	42	679
Four fundamental operations	272	27	4	303
Fractions	139	—	—	139
Factoring	142	—	146	288
Exponents	68	228	317	613
Radicals	—	66	226	292
Forming equations from data	77	—	135	212
Solving equations	64	93	266	423
Arithmetic	57	13	2	72
Miscellaneous	128	303	271	702

The following errors were sufficiently common to merit attention. The problems are listed in the first column and the errors corresponding to the problem in the second column.

PART I

Problem	*Error*
*Divide $15b^4-10a^4b^3$ by $-5b^4$.	Write as $-3+$remainder or as $10a^4b^3$ or as $-3+2a^4$.
Given $A=P(1+K)^2$. Find A for $K=0.2$ and $P=100$.	Seems to give trouble in arithmetic, substitution, exponents.
Divide $3-2b^2$ by $\frac{1}{b^3}$.	Either fail to multiply both terms; multiply by b^3; or both.
*Perform the indicated addition: $\frac{2}{y}+\frac{3}{x}$.	Fail to obtain common denominator.
Factor: x^3-8.	Do not recognize it as a special product.
*Solve for x in terms of a and b; $ax=2+bx$.	Frequently given as $x=\frac{2+bx}{a}$.
*Factor: $2ay+ax-by-bx$.	Fail to complete problem. Leave in form such as $a(2y-x)-b(2y+x)$.
All word problems were missed frequently	Non-classifiable.

* Were missed extremely often.

PART II

The least common multiple of 8, 10, 20, is (2, 20, 40, 80).	Did not know meaning of L.C.M. Usually chose (2).
The surface of a sphere of radius a is (πa^2, $\frac{4}{3}\pi a^3$, $4\pi a^2$).	Usually gave $\frac{4}{3}\pi a^3$.
The number $\sqrt{-9}$ is (real, imaginary, negative, rational).	Usually chose word negative.

PART III

Problem	*Error*
Write with fractional exponents $\sqrt{2a^2}$.	Did not know the relationship of fractional exponents to radicals.
Simplify: $(\sqrt{3})^4$.	Answers given as radicals with fractional exponents, or as an irrational number.
Divide: $3a^{3/4}$ by $a^{1/4}$.	Could not handle fractional exponents.
Multiply $6x^{-4}$ by $2x^2$.	Worked as if it were written $(6x)^{-4}$ times $(2x)^2$ or as if it were $(6)^{-4}x$ times $(2)^2x$. Sometimes disregarded minus sign of exponent.
Simplify: $\sqrt{\frac{2}{3}}$.	Could not rationalize denominator.
Find the highest common factor of x^2-4, $2x+4$, $a(x+2)$.	Frequently found L.C.M.
Solve for x: $\frac{6x+2}{x-3}+\frac{8}{x-3}=8$.	Omitted the problem.
Factor: $m^2-x^2+4cx-4c^2$.	Left in form $(m-x)(m+x)+4c(x-c)$.
Simplify: $\frac{1}{\sqrt{3}+\sqrt{2}}$.	Could not rationalize the denominator. Gave as $\frac{1}{\sqrt{5}}$.
Missed word problems.	Non-classifiable.

5. Uses of Test. The various tests, the A, T, D, used in computing the composite score, G, may be used separately in student counselling. The psychology or A-score is an index of inherent ability, the retention or T-score is an index of high school preparation and the departmental or D-score is an index of application in the course.

When a student is not progressing satisfactorily in his course his counsellor may investigate his scores on these three tests. If he has scored high on the G- and T-tests and low on the D-test it is clear that he has not been applying himself to the course. If his score is high on the A-test, low on the T-test and moderately high on the D-test, he has likely had poor previous preparation, etc. Thus the results of the A-, T-, D-tests have been found useful in helping students adjust themselves to their new mathematical experiences.

The test is now being used in the A.S.T.P. and V-12 programs. Each enrollee's score on the test is one of the elements used in placing the enrollee in a graded section. No statistical results on the data obtained from the test are available at this time.

The three tests, separately, or collectively, may be used to predict the probable success of the student in his college mathematics course. The composite or G-score may be used to predict the success of the student in his College Algebra course. This prediction may be made in many ways.

Case A. It may be assumed the percentages of the number of individuals receiving the scores A, B, C, etc. in the course and on the composite scores should remain constant. The following table shows 84 or 12.4% of the individuals completing the algebra course were scored A. The upper 12.4% of the scores on the G-score not necessarily made by the previously mentioned 84 individuals ranged from 53–60. Thus any individual with a G-score in the range 53–60 was predicted to score A in the course and similarly for the remaining scores.

Case B. A similar analysis was made using the T-scores in place of the G-scores. The following tables show the results in the two cases.

In Case A data was available in only 676 cases while for case B data was available for 704 cases. The remaining 28 cases in Case A represent incomplete records. The F-scores include the incomplete scores.

A

Range of Scores on G test	Grade in Course	Number	Per Cent
53–60	A	84	12.4
47–52	B	149	22.1
39–46	C	188	27.8
33–38	D	121	17.9
31–32	E	25	3.7
00–30	F	109	16.1
	Total	676	100.0

B

Range of Scores on T test	Grade in Course	Number	Per Cent
77–100	A	86	12.2
64–76	B	151	21.4
51–63	C	195	27.7
42–50	D	125	17.8
39–41	E	23	3.3
00–38	F	124	17.6
	Total	704	100.0

Results of Predictions:

Case A. The following table compares the score predicted from the G-rating with the actual score granted in the course. The rows give the predicted score and the columns give the actual score. Thus of the 84 scores of A in the course, 44 had been predicted to make A, 29 to make B and 11 to make C. It is significant to note that 44.6% of the predicted scores agree with the actual scores while 84.5% either agree or differ by at most one letter. Also 97.3% of the predicted scores agree with or differ by at most two letters from the actual scores.

Case B. A similar analysis using the T-score instead of the G-score follows: In this case 43.4% of the predicted and actual scores agree while 77.5% either agree or differ by at most one letter. Also 95.2% of the predicted scores agree with or differ by at most two letters from the actual scores.

A

Actual Score

Predicted Score on G test	A	B	C	D	E	F
A	44	32	7	1		
B	29	69	39	13		1
C	11	39	79	36	5	10
D		7	52	32	7	16
E		1	7	12	4	14
F		1	4	27	9	74

Per cent of predicted scores agreeing with actual score—44.6.

Per cent of predicted scores agreeing with or differing by not more than one letter point —84.5.

Per cent of predicted scores agreeing with or differing by not more than two letter points —97.3.

B

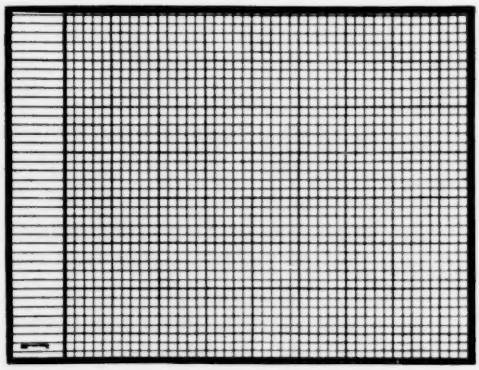
Actual Score

Predicted Score on T test	A	B	C	D	E	F
A	51	26	14	1		
B	23	73	35	14		2
C	10	43	85	32	4	16
D		5	45	37	12	30
E	1	1	5	5	3	10
F	1	3	9	33	9	66

Per cent of predicted scores agreeing with actual score—43.4.

Per cent of predicted scores agreeing with or differing by not more than one letter point —77.5.

Per cent of predicted scores agreeing with or differing by not more than two letter points —95.2.



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Mathematics in the War Program in the Secondary Schools*

By JOSEPH B. ORLEANS
George Washington High School, New York City

AT A CONVENTION of Deans last Fall in Albany, N. Y., one of the speakers, I am told, in discussing the guidance of pupils in these times of emergency, proposed as a slogan, "Praise the Lord and pass your mathematics." Whether she said this in a facetious vein or not, the comment points to a growing trend in secondary school guidance at least for the duration.

At the annual session of the National Association of Principals of Schools for Girls in February of this year, Dean Gildersleeve of Barnard College was quoted by the New York *Times* as urging improvement in the teaching of mathematics, as asserting that the secondary schools had not taught mathematics and English very well and that the war has uncovered the widespread unpreparedness of secondary students to go on in higher mathematics, and as saying, "It is not impossible that because of this weakness our country may actually lose the war." Quite a strong statement to make, coming from a leading educator of young women; but, of extreme significance for us teachers of mathematics if interpreted intelligently and without panic.

At a meeting of teachers of mathematics in New York City last month, after presenting a plan for changing radically the work of the mathematics of the tenth year in order to make room for military applications, the speaker urged the teachers to press their supervisors and to insist upon the changes that he had proposed and ended his exhortation with the words, "Let us win the war and preserve the peace with mathematics." He then followed this up in a letter to an opponent of his plan with the words, "A vigorous adherence to the old serves the cause of the obstructionists. Won't you try to unbend a little from the 'eternal verities' stand just for the duration?" A rather novel, flag-waving stand to take in a matter that is purely professional and merely concerns modification of a course of study. Perhaps it is most undesirable to permit this sort of thing to develop in our own field, for it may lead to the sort of thinking that I heard expressed a few days ago. A teacher who had criticised one of the courses in mathematics explained that he had not publicized his criticism because he did not want to be accused of interfering with the war effort. What nonsense!

During the past year, there has been an unprecedented flow of opinions about the part that our schools should play in the present emergency. Much has been said about such matters as 'the school and the war effort,' 'defense courses,' 'war courses,' 'a pre-induction program,' 'applications of mathematics and science,' and 'the preparation of our pupils for war and for peace.' Any schoolman who tries to follow seriously the avalanche of printed matter that has been overwhelming the schools from various sources is veritably bewildered in an effort to adhere to the fundamental values of secondary education, just as we are urged by our leading statesmen to continue to adhere to fundamental values in life in general in order to be prepared for life after the war. And so, let us examine some quotations and try to put together, if possible, a whole picture out of these pieces of a huge jig-saw puzzle.

1. From a bulletin issued by the Director of Secondary Education of the New York State Department of Education

* A paper read before the Connecticut Valley Section of the Association of Teachers of Mathematics of New England, Springfield, Mass., April 17, 1943.

entitled 'Secondary Education in Wartime' we find: "Present military training programs in all branches of the Army and the Navy and related air services are based on a foundation furnished in public schools. Conferences held with military authorities have served to emphasize the importance of the foundation furnished by the regular secondary school program, particularly in connection with instruction in English, social studies, mathematics, and science. . . . Although total war confronts schools on the alert with a necessity for making programs even more positive and more in line with exigencies of defense, educational gains need not be sacrificed. . . . Our program of mathematics must be strengthened. Mathematics constitutes an integral part of the foundation upon which much military training rests and must be made available to an increasing number of secondary school pupils. Boys in high school who are capable of profiting from a study of mathematics should be encouraged to elect algebra, geometry, and trigonometry. Many boys should also be encouraged to study solid geometry. . . . Furthermore, military authorities have indicated most positively that they are not interested in applied mathematics courses, but rather in the regular courses which stress the fundamentals."

2. From a talk by B. M. Venable, Colonel, General Staff, War Department, before the Annual Convention of School Administrators, February, 1942: "Your algebra will not have to be starred as defense algebra, nor will your physics have to be called military physics. Yet you are desirous of doing your part; and I can assure you that the War Department considers it most important that the high school student take advantage of every minute of education available to him now and in the near future eventually including a college course. If there must be a fanfare and military glamour present to attract them, let's have it; but the War Department hopes that the normal educational activities of the high schools will be interrupted as little as possible. It is still believed that a healthy training of mind and body is the best contribution the schools can make. The War Department cannot ignore the value of other subjects in preinduction training, but there are many subjects, dressed in khaki sometimes, that will have little or no application in the service; and we would like to offer a request that you do not temporize with the situation, that you do not stampede in all directions seeking some magic course, because you will very likely find that you have the essentials already in your curriculum. . . . More effort should be required of the student. A higher standard should be set, lots of home work and midnight oil."

3. From a speech by Paul C. Smith, Lieutenant Commander U.S.N. before the Annual Convention of the Association of School Administrators, February 1942: "First and foremost, you can help the Navy immeasurably by the simple expediency of stressing those of your regular subjects in which the Navy has found the present recruits most lacking. Mathematics is the most important of these, followed closely by science and manual subjects. . . . So the Navy asks that you encourage every male student under your supervision who has the slightest aptitude for such subjects to take an absolute minimum of two and one half years of mathematics. Teach him algebra through quadratics, plane and solid geometry, and trigonometry. Ground him well in chemistry and physics. Give him practice in machine shop work, foundry work, metalworking, woodworking, and internal combustion engineering. The most important group, because it is the most basic, is mathematics. . . . Yes, mathematics and science and manual subjects as well are actually necessary in the Navy. But they will be equally necessary in the peace that follows. The forces of destruction that have been unleashed upon the world have been planned by the most scientific minds in the world. The minds which rebuild after this

destruction must be equally scientific and even more ingenious. It will take educated and trained men to heal civilization's wounds."

4. From a talk by J. Kadushin of the Education Department, Lockheed Aircraft Corporation, before the National Council of Teachers of Mathematics in February 1942: "Progress in industry has been such, in the past several decades, that blind application of empirical formulas and methods handed down from father to son and from experienced mechanic to apprentice is becoming more and more unsatisfactory. . . . The tool designer and the tool planner, while not using the highest levels of mathematics to any great extent, must have a good thorough basic foundation in algebra, geometry, analytical geometry, trigonometry. and in some instances differential and integral calculus. To supply this need is very important in present day industry. . . . Among high-skilled trade such as machinists, tool makers, die makers, loftsmen, template layout men, and so on, mathematics is as much a tool as their scale, dividers, and straight edge. In many instances these craftsmen have attained their skill from practical experience. As long as consecutive jobs are familiar enough in nature so that a rule of thumb procedure can be used, or a certain page in the handbook referred to, all is well. However, when a new project diverts somewhat from the familiar and well-traveled path, a lack of sufficient mathematical ability can be disastrous. These people must have proficiency in the use of algebra, geometry, and trigonometry."

5. From a bulletin of May 1942 issued by the New York State Department of Education entitled Basic Educational Requirements for Military Services we read: "In response to an inquiry (at Fort Belvoir Corps of Engineers) as to the value of special courses that might be organized at the secondary school level, the Commanding Officer and members of his staff stated that, in their judgment, such courses would be of little value to boys entering the armed forces. It is their belief, however, that it is possible to include in the present mathematics and science courses, materials that would be of great help. . . . In response to the question (at Fort Monroe, Coast Artillery Corps) as to whether special courses of any kind should be offered in the secondary school as basic preparation for the artillery, it was stated most emphatically that such courses would not be appropriate, but that the basic subjects (arithmetic, algebra, plane geometry, plane and spherical trigonometry, solid geometry, physics) plus the fundamentals of radio would constitute the most satisfactory secondary school curriculum. . . . It was suggested to the officers at this aviation center (Maxwell Field, Air Corps) that mathematics, science, physics, astronomy, meteorology, principles of navigation, etc., might be offered at the secondary school level as a special pre-flight course in aviation. After careful examination and consideration of such proposals, the army instructional staff was of the unanimous opinion that such courses should not be offered in lieu of mathematics and physics. It was stated most positively that the foundation that might be furnished through the regular courses in science and mathematics now offered in the secondary school provides a satisfactory basic preparation for entrance into the Air Service. . . . It was suggested by the Director of Training that some illustrative and problem material from the field of aviation should serve not only to motivate the regular school work in mathematics and science, but would improve this work by making it more practical and more meaningful to secondary school pupils."

6. From letters* received by the writer from three boys in service as follows: (a) From Leonard Garber, 2nd Training Co., O.C.S. APO 923, somewhere in the Pacific: "We had a brief course on basic mathe-

* These letters are in the possession of the writer.

matics which amounts to higher arithmetic, introductory algebra, and trigonometric ratios. It was truly pitiful to see the fellows struggle with fractions, decimals, and formulas. Each wanted to know the subject, each deserved A plus for effort, but only the special few knew what was going on."

(b) From Abraham Thompson, U. S. Army Air Forces, Ellington Field, Texas: "The Pilot Preflight course begins with simple arithmetic, goes through elementary algebra, proportion, wind resistance and vector problems. Most of the boys have a harder time at the beginning than at the end. It seems the majority have trouble with fundamental stuff. The Army's time is limited and they don't waste too much time explaining. A fellow has to work a lot of it out in his spare time, of which he never has too much. Little things like square root, simple algebra such as solving for the unknown and proportion give a lot of trouble. The courses are pretty well interwoven. Physics requires a good knowledge of that same fundamental stuff they are missing in mathematics. A fellow cannot work his physics formulas unless he is straightened out in mathematics. In Navigation School they go faster still. They begin with conversions from nautical terms to statute terms. Trigonometry is added as well as logarithms. They finish up with vectors and radius of action problems. The biggest trouble here is accuracy. We are told the main reasons for washouts in Advanced Piloting are carelessness and lack of accuracy. . . . What I am trying to say is that a sound foundation in high school mathematics will get a man by any of these Air Force courses. . . . That year of mathematics I took in night school was certainly worth the time I spent on it."

(c) From Stephen Ananian, Aircrew Flight, Albright College, Reading Pa.: "I want to thank you for my training in trigonometry. Even though my mark was relatively low, it seems I got much more out of the course than the mark shows. The proof of this is in what I am about to tell you. A few months ago I joined the Air Corps as an aviation cadet. They gave us a tough test in mathematics, physics, and aerodynamics—one hundred and fifty questions. The mathematics consisted of algebra, intermediate and advanced, plane and solid geometry, trigonometry, and some calculus. I came out eighth highest of the one thousand that took the test. The subject that tripped everyone besides aerodynamics was trigonometry. As for military applications in the high school course —I do not think it makes much difference, although such a course might create a greater interest in the course by those students who might not be interested otherwise. I remember that a problem which contained something of an engineering 'air' to it would challenge our wits. So I think that military applications might help a lot of students study and they might probably help slightly later on in the armed forces, but not much."

7. From a letter by Randall Jacobs, Rear Admiral U.S.N., Chief of Naval Personnel, to the Editor of the Bulletin of High Points (September 1942): "The public schools can actually shorten the war and save the lives of thousands of men, if they will teach the mathematics and science basic to all technical service training and teach these subjects so thoroughly (even to the point of over-learning) that it will be unnecessary for service schools to spend the early weeks of technical training in a laborious review of elementary mathematics and of those phases of physics which are essential to an understanding of the principles of electricity, light, sound, and motion."

8. From a talk by Davis H. Moskowitz, Assistant Superintendent in the High School Division, New York City, before the Mathematics Teachers Association, October 1942: "If any one of you entertains the thought that business on the mathematical front is to be 'business as usual,' he is to be rudely and uncere-

moniously shaken out of his boots. Anyone who contends, as some have done, that the good old traditional and logical organization of mathematics is made to order and is the best preparation for the needs of this war, should be forcibly shocked out of his inertia and lethargic condition of criminal somnolence."

9. From 'A Wartime Program in Mathematics and Physics' proposed by the National Council of Chief State School Officers, May 1942: "The conference was in full accord on the necessity for immediate strengthening of the physical science and mathematics program in the secondary schools as a contribution to the military and industrial phases of the war effort. Also, emphasis was placed upon the necessity of maintaining, even in the present emergency, a well-balanced program of secondary education with carefully guarded emphasis upon those fundamental objectives that must be attained to insure the continuance of the democratic way of life."

10. From the New York *Times* report (August 30, 1942) of the Institute on Education and the War, Washington, D. C.: "More and better courses in mathematics and physics in the high schools were urged upon the educators by Major Francis Parkman of the Army Air Forces and Lieutenant Daniel Brimm of the Navy's Bureau of Aeronautics, both of whom appealed for training in fundamentals rather than the offering of specialized courses in aviation. Training in these subjects will enable the military forces to turn out qualified aviators in less time. Too much time now must be spent in military aviation training courses supplying the fundamental mathematics and physics."

11. From the New York *Sun* of October 1, 1942, a report of a statement by the Superintendent in charge of High Schools, New York City: "Commenting on the request of the Bureau of Navy Personnel for thorough training of high school students in mathematics and science even to the point of over-learning, the Superintendent said, "We are going along with the Navy in the belief that we need thoroughness of instruction in mathematics and science. However, we do not go along with the Navy's insistence on the traditional formalized courses and technics of study in mathematics and science. We want the same principles retained, but we want the subjects taught in relation to their practical application to life. In addition to the basic courses, we want to make sure that the pupil know all the relevant practical applications."

12. From a bulletin issued by the Mathematics Curriculum Committee of the New York State Department of Education, June 1942: "As to war problems, the Department is not yet ready to recommend a wholesale injection of such material into our courses. We should be very sure that we do not get into an amateurish and futile dabbling with all sorts of technical material. Nevertheless, the secondary school can increase its effectiveness in this respect by the introduction of illustrative materials and practical problems based upon the present mathematics program without distorting its framework and without sacrificing its basic values for general educational purposes."

13. From a talk by Colonel Edward A. Fitzpatrick of Selective Service Headquarters in Washington, D. C., at a meeting of the National Vocational Guidance Association in New York, February 13, 1943: "Mathematics should, as far as possible, be included in the curriculum, but it will have to be mathematics more closely related to actual problems *with no less emphasis on mathematical principles.*" At the same meeting, Lieutenant Commander Earl J. McGrath of the Navy pointed out that, if the specialized educational program of that branch of the service is to be carried on expeditiously and efficiently, it must rely on the schools to provide a good basic education, and that wherever possible they should strengthen their programs of basic general education, especial-

ly in fields related to the work of naval officers and enlisted men.

What is one to make of these contradictory opinions and bits of advice? Keep the basic mathematics, abandon mathematics as usual, introduce wartime applications, don't dabble with war problems in amateurish fashion. Should one regard more seriously the advice of the representatives of the armed services who are concerned directly with the training of the men in their care, or that of educators who have been away from the detailed problems of the classroom for many years and who cannot know through first-hand experience of the difficulties which the teachers are experiencing in the teaching of mathematics in the war program today? How seriously shall we accept the statements of the young men in service from whose letters I have quoted? I suspect that they certainly know what their needs are. Perhaps the advice we might well accept and try to follow is the last quotation, "It will have to be mathematics more closely related to actual problems *with no less emphasis on mathematical principles.*" But we must also find the answer to the question, "To what extent can those 'actual problems' be used meaningfully in the classroom, and what is to be sacrificed in order to provide the time for the new material?"

It becomes important for us to re-examine our philosophy of education and to see whether we still believe that mathematics has something worth-while to contribute to the development of our growing boys and girls. Just as English, social studies, science, the arts each have a unique offering for our pupils, so mathematics, if properly taught, helps to bring about desirable changes in them. I hope you will agree with me—I am certain that most of you do, even though some may regard what I am going to say as old fashioned—that, even in time of war, we want the study of mathematics to continue to develop in our pupils 'the will to perfection, effective habits of work, the habit and the power of analysis, open-mindedness, the courage for truth, the habit of reflection, freedom in thought, and reverence,' those ultimate objectives at which every conscientious teacher aims in his teaching. Certainly it is desirable that boys in service have these qualities, in addition to the mastery of mathematical skills and concepts and principles. I am inclined to feel that the Army and the Navy and the Air Services would prefer men with these qualities and little experience with so-called war applications of mathematics, rather than others with only a superficial dabbling in applications of the type they must of necessity meet in the high school classrooms. The men will learn their applications more effectively when they are in service, if they come with that mastery of the mathematical skills, concepts and principles.

I am certain that there is nobody among you who disagrees with the stand that our high school courses in mathematics must undergo some changes. The terms 'basic' and 'fundamental,' as used in reference to mathematics these days in the war program in the high school, do not at all imply adherence to mathematics as it has been taught traditionally with a great deal of useless manipulation and meaningless symbolism. They refer rather to those parts of the subjects which are a sine qua non for the ability to advance in the subject and to use the mathematics with understanding in the fields in which it is applied. It is desirable that arithmetic as such be not disregarded in any year of high school mathematics when the need for a review or even a re-teaching of an arithmetic topic arises. It is desirable that there be closer relationship between algebra and geometry in the development of the content of the ninth and the tenth years. It is desirable that there be greater emphasis on certain topics because of their importance today, the angle, the parallelogram, locus, the formula, ratio and proportion. It is desirable that changes be likewise introduced in the work of the eleventh

and twelfth years of the high school.

The practical aspect of mathematics has been neglected in the past. The pupils have been fed on artificial and puzzle problems. Formulas have been handed out without any attempt at explaining their origin. There is no doubt that in many instances the mathematical concepts and principles acquire real meaning for the pupils, if they are associated with understandable and usable applications as motivation and illustration. But, let us be truthful with ourselves and really recognize how much of this can actually be done in the mathematics classroom, without taking a great deal of valuable time from other more important topics. For how many formulas can the teacher of mathematics really give his pupils the complete background? How many problems can be introduced without a certain experience in technical material which is lacking in the training of both pupils and teachers? Let us not attempt more than we can truthfully handle. Let us not go overboard in the name of 'war applications.' Let us make changes that will be far reaching enough to be desirable also in time of peace. Let us not bandy about those artificial slogans that make one believe that continued stress on the basic and fundamental values of mathematics is a dis-service to our young high school boys and girls and to our country at war.

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Mathematics in Our Schools and Its Contribution to War*

By Sophia H. Levy
University of California, Berkeley, California

Until a year ago, statements that our high school graduates could not do arithmetic were dismissed as of no consequence, in fact, were almost not believed. But Admiral Nimitz's letter concerning the failures in arithmetic tests given recruits entering the Navy, coming as it did at the very beginning of the War, got people more "arithmetic minded" in a few weeks than had all the efforts of teachers of mathematics in our secondary schools and colleges in nearly twenty years. Suddenly arithmetic has been revived. Suddenly there has been a large increase in the number taking courses in mathematics in the secondary schools. Suddenly there has been a large increase in the number taking courses in secondary mathematics at the University. During the semester now closing we have had 3600 students in our department as against 3000 one year ago. This is an increase of 20%, though our University enrollment dropped from 15,000 to 11,000, and enrollment in advanced courses in mathematics suffered a large drop during the same interval. We have had 1100 people taking courses in secondary mathematics. We have had 500 taking intermediate algebra with background of but one year of elementary algebra.

One year ago I addressed some 400 letters to schools over the country, asking what mathematics was being given or contemplated to meet war needs. Over 100 replies were received, and practically all expressed the belief that the need was for the teaching of the fundamentals, rather than the teaching of specific applications. Questions put to representatives of the armed services brought the same reply—"We want the men to come to us with mathematics—*we* want to teach them the applications of mathematics to our field." Such is still their opinion. I have recently addressed the same inquiry to 250 schools. I sent these letters because I was troubled over the situation in which I thought our subject stood at the time. Many are optimistic, for there seems to be abundant evidence that mathematics courses are being added to the programs of many schools. I was concerned over the fact that *fundamentals* were so uniformly popular in these new courses, even to those who for years have declared that the subject of mathematics was of no use or importance to anyone other than an engineer or perhaps a person bent on further work in mathematics or in a mathematical science. My belief was that the administrator was setting up *his* definition of *fundamentals*. Hence my second set of letters. My fears have been more than confirmed. *Fundamentals* have certainly undergone great changes.

The replies are exceedingly disconcerting. The subject of mathematics has been divided and redivided, and divided again: if you want to be a pilot you take one kind of course, if you want to be a navigator you take another, if you want to be a radio operator you take another. If you want to be an electrician you take another, to say nothing about what you do if you want to be a bombardier. And so on. Each group is given a *different* training in fundamental mathematics! If you are to work on airplanes you apparently need a different mathematics from that of any of those who go into the air. And so on *ad infinitum*.

Every day brings forth a new textbook

* A previous paper with this topic appeared in the May 1942 issue of The Mathematics Teacher. Present paper was read before the Northern California Section Mathematical Association of America, San Francisco, California, January 30, 1943.

or literature concerning one about to appear. Many of them have not been written with care. I quote from the rules which one says should be *memorized:* "Raise both sides of an equation to the same power or extract the roots of both equations without changing its equality."—"Remove like factors from both sides without changing the equation."—"Multiply both sides of an equation by -1, changing all signs in both equations." Certainly *this* kind of *fundamental* work can do much harm both now and in any post-war use to which one might put his present studies.

They say that trigonometry must be taken aloft. It is now out of style to talk about ships on the ocean or places on the earth. New books have taken trigonometry aloft. It didn't take much trouble either—the old problems still appear. Ship becomes plane, plane becomes ship, elevation becomes depression, or train becomes plane, box becomes airplane gas-tank. Middle latitude sailing has gone aloft! And a plane can go at high velocity for several hours and follow the rules of the game of plane sailing!

We must become air-minded. In fact, large sums of money are being spent on the air-conditiong of the American public. This air-conditioning is to start in the primary grade and is to be continued throughout every grade of school and in every course in arithmetic and secondary mathematics. I do not question the importance of this work in certain fields, but I do question the wisdom of placing any major part of the mathematics taught in our schools under preflight and similar programs. This is being done. It is my belief that mathematics at this time is in a much worse position that it has ever been in the past.

It may sound innocent enough to talk about preflight biology, which is just one of the many preflight subjects. Naturally it is interesting to the boy to read about what can happen to a pilot when the plane goes to great altitudes and what happens to the pilot if the plane descends too rapidly. I understand that boys have even been known to give up football practice to hear about the bends. They know more about bends than how to figure the amount of gas needed in a plane to complete their journey. I am told, too, that mathematics is given in this course. In fact, I was told that this class had "developed the law of falling bodies."

I know of a seven-year-old writing a speech to be delivered before his class on the subject, "How many Japs can be killed with the bullets made out of an electric train?" Contrast this with a story told by Superintendent Nourse of the San Francisco schools the other evening. He had received a letter from a little girl in England in which she told that the children take their arithmetic books with them when they have to go to air-raid shelters, where they work arithmetic problems. "We won't allow Hitler to spoil our lessons."

It is one thing to do patchwork for the senior, for he needs to get his mathematics quickly. It is another thing to do patchwork for the student who has time in which he could be given *real* fundamentals. The first duty of our schools is to undertake thorough programs. There is great danger that the impression of being extremely patriotic and extremely busy on patchwork may lead people to ignore the essential job; *in this essential job no waste is involved.* If the war continues so long as to draw in those who are now starting high school there can be no argument. When the war ends, the fundamental training in mathematics which these boys and girls will have had will be of far more benefit than anything else on which their time and effort could have been spent. Surely we cannot agree with the school administrator who recently announced at a meeting that the schools were no more to be chided for not teaching mathematics to more people than for overlooking the training of everyone to be a riveter!

The Cubic*

By Olive Leskow
Tolleston School, Gary, Indiana

Characters

Chronicler	Tartaglia
Fontano	Mother of Tartaglia
Cardan	Ferrari
Father of Cardan	Messenger boy

Act I

(Chronicler comes in from the left in front of curtain. Stepping aside he points to the curtains that are about to open. He reads from a scroll.)

Chronicler: Ladies and Gentlemen, you will now behold upon our stage the character of Nicolo, which we this day call Tartaglia, the stammerer. Born in the sixteenth century in Brescia, he became the greatest mathematician of Italy. As a child he was present at the taking of Brescia by Gaston de Foix and at that time received a saber cut in his face which caused an imperfection in his speech. This gave him the nickname, Tartaglia. Since his mother was widowed when he was yet a tiny boy he was self-educated. She found it too difficult to pay his tuition. After overcoming many obstacles he learned to read and picked up a knowledge of Latin, Greek and mathematics by himself, and was able to appear as a teacher at an early age.

I now bring to you Tartaglia in person. (He walks out to the left as the curtains open.)

Scene: The home of Tartaglia in Brescia, 1523, late in the year. Tartaglia's mother, a woman of about fifty, is cooking by the fireplace at center back, and Tartaglia, in his twenties, is studying near a small table at the extreme left of the stage. There is a door at the rear right. A few chairs and benches are scattered about the room.

Tartaglia: Arma virumque cano, troiae que primus ab oris (pauses) troiae que primus ab oris.

(Fontano rushes in excited)

Fontano: Mama, I have another pupil for Nicolo. His father wants him to study Greek and mathematics.

Tartaglia: Another student for mathematics. May the subject progress!

Mother: Your father, my sons, wanted you to go to school and study Greek and Latin, rather than be troubled with a subject like mathematics. But he died before you were old enough to appreciate what he wanted you to study. (Sighs) I am sure you will not gain much by studying such a new subject. Nicolo, why do you waste your time on such nonsense?

Tartaglia: Italiam, fato profugnus, Lavinia que venit. (Closes his *Virgil*) Mama, there is mathematics in artillery and in war equipment. Wait! Before long I shall finish my book. The public will then awaken to the fact that there is mathematics even in the making of gunpowder.

Mother: Son, why do you mention the products of war. (weeps) Do you not remember that even you yourself were hurt at the taking of Brescia twenty years ago? Did you forget how Gaston de Foix overran our town? Look at the saber cut on your face. It should remind you of how terrible war is.

Fontano: (Looking at some loose paper which was lying near Tartaglia.) Yea, and that's why you stutter too, Tartaglia. What's this! What kind of mathematics do you call it?

Tartaglia: That is algebra. More than a thousand years ago, a Greek, Diophantus, worked out a system by which he could solve many problems. But this system remained undeveloped until—

* *Author's note:* The central plot of this play is based upon the impression I got from reading Vera Sanford's, *A Short History of Mathematics.* There may be some disagreement as to whether Cardan obtained his solutions through force or through playing into the role of Tartaglia.

Fontano: Oh yes, I remember, the Arabians took it up in the ninth century. But you give them too much credit. The only thing they contributed was the title.

Tartaglia: But remember that Musa al Khawarizm, although an astronomer, wrote the first algebra.

Fontano: (Sitting down by the dinner table.) But I think the Chinese deserve more credit. They contributed the "celestial method" of solving equations and it certainly made a decided advance in the solution of numerical equations.

Tartaglia: (Getting up and pacing the floor, pauses and looks up at the ceiling.) Three generations ago Scipione del Ferro asserted that he had solved the cubic equation $x^3+mx=n$. His ambition is said to have been stirred up by Luca Pacioli, a member of the Minorite order. (Picks up a small piece of paper from his messy desk.) I got it! (thinking) No! this solution is wrong.

Mother: Let us dine, my sons.

(All sit around a table and say grace while the curtains fall.)

Act II

Chronicler: (Reading) Tartaglia knew that only Fior held the solution to the cubic equations and since challenges for the rank in the new line of mathematics were prominent in those days Tartaglia challenged Fior. Each was to set thirty problems for the other. The man who solved the greatest number of problems in fifty days was to become the victor. Being anxious to defeat Fior and knowing that his opponent had a scheme for solving a particular type of a cubic equation, Tartaglia devoted his time to devising a method for solving a cubic equation in which the first degree term was missing. Having done that he turned his attention to the type in which the second degree term was missing. In the meantime, another mathematician, Girolamo Cardano, was becoming famous.

I will now take you to Pavia, Italy. It is exactly a year later.

Scene: In a little village at Pavia a year later. A very old father is reading a book at a table in the center of the room. Girolamo is smoking up a piece of glass by the crude fireplace at the left. There is a door and a window at the rear.

Father: It is exactly fourteen years ago when I edited this book of Peckham's.

Cardan: You mean your *Perspective Communis?*

Father: Yes, what publicity it did receive in those days. I was then a professor of jurisprudence and a little later a physician at Milan and you, son, what do you have to say for yourself?

Cardan: Why, I practiced medicine at Milan, too, but that doesn't interest me.

Father: Why are you smoking up that glass?

Cardan: Father, if I smoke up the glass I will be able to look at the heavens and the sun will not hurt my eyes.

Father: Son, you are indeed quite intelligent, but it's evening now. You will not be able to use it now.

Cardan: (Walking over to the window) I can see the small dipper so plainly tonight. What a lovely night to study stars!

Father: The stars again! Why can't we discuss medicine for once?

Cardan: (Disregarding his father) By ram's head I bet that those stars predict the fates of our lives!

Father: (Aside) I was always afraid that my son would be a gambler. And his way of hurriedly wishing to make a bet certainly brings out the gambler's trait in him. (to Cardan) Son, how many times have I told you to stop that habit of yours. Always making a bet. (A knock is heard) Come in.

Messenger boy: (at the door) A message for you, sir.

Cardan: (walking over to the door) Here is a bun for you, son. Thank you for the message. (Reads the message)

"Fior challenged Tartaglia. Tartaglia spent two weeks in developing a proof for two important cubic equations. When he developed them he solved the

problems that were set before him in less than two hours."

So Tartaglia won the contest!

Father: I don't like Tartaglia. He was accused of plagiarism. Was he not?

Cardan: I think you're wrong, father. He worked on those cubic equations by himself. I'm sure he didn't get it from anyone.

Father: No! I know what I'm referring to. Tartaglia claimed the original discovery of applied mathematics in artillery and said that it was his own idea.

Cardan: Well! that is partly attributed to his ignorance of the literature of the subject. You know he is self-educated. (Sits at the table and scribbles something)

Father: (Walks over to the window) Cardan, your pupil is coming. He seems to be angry.

Ferrari: (Rushing in, tearing his hair) I won't forgive him, no, I won't!

Cardan: Lodovico, don't you let that ungovernable temper of yours get the best of you again. Come, I'll show you how to play with numbers. (Picking up a slate from the table.) Look! Make a square and divide in into nine parts. In each small square put a number, using one to nine. Arrange them so that each row would sum up to fifteen. Here! see if you can do it. (Ferrari takes it, and works it very quickly.)

Father: (Aside) If I were training that pupil, he would soon be a teacher at Milan, and I'd get rid of his blasphemous habits.

(Curtains close)

ACT III

Chronicler: (Reading in front of curtain) Thus Girolamo Cardano was a man of remarkable contrast. He was an astrologer and yet a serious student of philosophy. He was one of the students of the well known clock problem. He is said to have been a gambler, a man whose statements were extremely unreliable. He was a father and defender of a murderer, an inmate of an almshouse, and a victim of blind superstition. On the other hand he is known to be a first class algebraist, a physicist of accurate habits of observation, a physician, a professor and rector of Medicine at Milan. "Always a man of genius, always a man devoid of principles."[1] As to his work, the most noted was *Ars Magna*, the first Latin treatise devoted solely to algebra. In this book he printed Tartaglia's cubic solutions, which were imparted to him under a secret oath. We now will show how he came to get the solutions and what happened then.

SCENE: Cardan and Ferrari on stage.

Home and furniture the same as in Act II.

Cardan: I've tried my best to get the solutions to the cubic equations from Tartaglia, but all in vain. He will not give them up. (He sits on a little stool and weeps. His face in his hands) All hopes are gone!

Ferrari: Master, do not weep. I'll try to help you. (He stops to think.) I have it! Why not go and tell Tartaglia that he is invited to some important meeting and I'll prepare the rest. He will have to give the secret up then.

Cardan: (Looks up and becomes very thoughtful) I'll go. I'll tell him a wealthy nobleman wishes to arrange a meeting at Milan between mathematicians and his would-be patrons. And you Ferrari stand behind that open door and when we walk in, shut it. This will be my last hope. (Cardan leaves)

Ferrari: What was I doing. Oh, yes, this treatise. Aha! so it belongs to Tartaglia. (He sits down and picks it up) Here he explains his theory of complements. (Reads) 8×6 is the same as 10×6 minus 6×2, the complement of 8. (Thinks) 8×6 is 48 and 10×6 is 60. (Counts on fingers) 6×2 is twelve. Then $60-12$ is 48. Why! that's remarkable. (Reads to himself. Getting up rather shocked.) I'd better arrange the room for the mathematical meeting. (laughs aloud) Ha! Ha! Ha! What a joke this will be. (He cleans the room a bit)

[1] D. E. Smith, *History of Mathematics*, I, 196.

Now this looks more like a meeting. Doesn't it? I better hide behind the door. It's about time that they were coming. (He leaves. The stage is silent for a time.)

Cardan: (Outside) Here we are, Nicolo, at the home of the nobleman. (They walk in.)

Tartaglia: Your noblemen aren't so wealthy as I thought. I would estimate this to be a nobleman's barn. Say! (hears the door being locked) What do you want to do to me?

Cardan: (Laughs) Ha! Ha! Ha! Now you must give me the solutions to the cubic equations.

Tartaglia: I can't, I left them at home.

Cardan: Oh, no, you didn't. You can work them without referring to the written solutions. Here is a paper and pen. You must work them if you wish to live.

Tartaglia: (Rushing to the door) I won't work them. Not for you. (Bangs with his fist on the door)

Cardan: (Laughing) It's locked. Come, come, settle down. Come take a seat here on the bench near me and let us talk like friends.

Tartaglia: But I tell you, I will not give you the solutions!

Cardan: Forget the solutions for a while. Come, let's talk our problems over.

Tartaglia: All right, but remember, I won't give you any solutions. (Comes towards Cardan slowly and sits down)

Cardan: It certainly is remarkable how mathematics, and especially algebra, seems to progress in Italy.

Tartaglia: Ahem!

Cardan: Why is it that you conceal the secret of your solutions. You are getting old and what good will it do you to keep it away from the world.

Tartaglia: Ahem!

Cardan: Now, if you would give it to me I would add to it, and pass it on to other young lads. I promise you that you will still have the credit of being the discoverer of such an important solution.

Tartaglia: Ahem!

Cardan: Come, come, write the solutions on this paper (Presents a piece of paper to him.)

Tartaglia: All right, but not until you take an oath before God that you will keep it a secret.

Cardan: Settled! If you want it to be a secret, it shall be so. I won't be afraid to take an oath.

Tartaglia: Say after me, "I promise before God never to reveal the secret of these solutions."

Cardan: I promise before God never to reveal the secret of these solutions.

Tartaglia: If God wills it to be so, so it shall be. (Takes a paper from his pocket and hands it to Cardan) Here it is, but remember the oath. It will not be I who will punish you, but God. Now, let me go!

Cardan: Lodavico, open the door. (The sound of a door being unlocked is heard.) Good day. Thank you for the solutions!

Tartaglia: Good day. (Exits) (Ferrari enter)

Ferrari: Do you have the solution?

Cardan: Yes, the plan has worked. Now I can continue with my book. With these solutions, the book will be ready for publication.

(Curtains drop for a few seconds)

Chronicler: (Reading) Thus *Ars Magna* was completed and published. Cardan claimed the solutions to the cubics for his own. Let us see what will happen now.

(Curtains rise)

Cardan: So! I am challenged to a duel. Well, Lodavico, I have always been your good master. Furthermore, your ideas have saved me many times. Now I ask of you to answer my duel.

Ferrari: I won't be afraid. I'll get all our friends to stand for me and believe me, Tartaglia will not escape alive this time. (Laces his sword on.)

(Ferrari leaves)

Cardan: (Sits down and studies. A knock is heard. He goes to the door) What is it? Oh! Lodavico. Home so soon! What has happened?

Ferrari: We met Tartaglia for the duel, but he escaped. Thus we were forced to leave.

(Ferrari shuts the door and begins to unlace his sword. A knock is heard.)

Ferrari: I'll answer it. (Opens the door) A message. Thank you, son. (Hands the message to Cardan)

Cardan: (Reads) "Since you refused to have a duel, let us dispute the question by a contest. I challenge you and Lodavico Ferrari. I will present thirty-one problems for you to work in fifteen days. You may do the same for me." (Lays aside the letter) All right! Two against one may not be fair, but he asked for it! We will accept his challenge!

(Curtains fall)

Chronicler: And thus Ladies and Gentlemen, Cardan presented thirty-one problems and Tartaglia did the same. Tartaglia rejoiced at the end of seven days, but Cardan and Ferrari spent five months working their thirty-one problems. Having finished them, they found the work all in vain. All but one solution were wrong. Thus ended the contest.

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Report of Sub-Committee of Mathematics Section of the Association of Private School Teachers

By Margaret E. Thompson
New York, N. Y.

On February 27, 1943, this committee sent forty-seven copies of a questionnaire to the heads of Mathematics Departments, Deans and Directors of Boards of Admissions, of forty Eastern Colleges.

The purpose of this questionnaire was two-fold: first, to obtain information on the use and importance of the mathematics section of the Scholastic Aptitude Test; second, to crystallize the opinion of college teachers on the importance of four years of secondary mathematics.

The questionnaire was sent to colleges which use the C.E.B. examinations, or are of particular interest to our private school pupils. The list of colleges was selected to include various types of institutions. Questionnaires were also sent to certain college teachers whom we know to be interested in secondary education.

The following summary is compiled from the answers sent by twenty-five colleges, fifteen of which are women's colleges and the remaining ten, men's colleges.

These colleges are:

Barnard
Bryn Mawr
Connecticut College for Women
Goucher
Middlebury
Mount Holyoke
New Jersey College for Women
Pembroke
Simmons
Smith
Swarthmore
Sweet Briar
Vassar
Wellesley
Wells
Amherst
Brown
Harvard
Lehigh
University of Pennsylvania
Princeton
Union
Wesleyan
Williams
Yale

Summary of answers as described above.

Question 1.

Of the 15 women's colleges,
None weight the mathematics section as a specific per cent
2 qualify their answers by the statement that the relative importance of the two sections of the S.A.T. depends upon the course which the candidate proposes following in college.

Of the 10 men's colleges,
6 give *no* specific weight to the mathematics section,
2 of the 6 qualify their answers as above,
1 counts the mathematics section as 40%,
1 counts the mathematics section as 50%,
2 count the mathematics section as about 50%
(Engineering schools count it 100%).

Question 2.

Of the 15 women's colleges,
None use the C.E.B. achievement test,

Of the 10 men's colleges,
8 do not use the C.E.B. achievement test,
1 has waived its use during wartime,

1 uses it in some cases.

(2 of these men's colleges note their inability to use this test because it is given at the same time as other achievement tests.)

(There is reason to conclude from answers to other questions that several colleges give their own achievement tests in mathematics for placement.)

Question 3.

Of the 15 women's colleges,

2 provide alternate courses on the basis of the S.A.T.

1 provides alternate courses on the basis of achievement tests,

1 provides alternate courses on the basis of either,

11 do not use the tests this way.

Of the 10 men's colleges,

4 provide alternate courses on the basis of the S.A.T.

1 provides alternate courses on the basis of achievement tests,

5 do not use the tests this way.

(All engineering schools require the comprehensive achievement test of all entering students.)

Questions 4 and 5.

Of the 15 women's colleges,

8 have suitable advanced courses for well-prepared students,

4 have suitable Freshman courses for well-prepared students.

3 consider their Freshman course sufficiently difficult for all.

Of the 10 men's colleges,

3 enter well-prepared students in Sophomore Mathematics.

3 enter well-prepared students in suitable Freshman course.

4 consider their Freshman course sufficiently difficult for all.

Question 6.

Of the 15 women's colleges,

4 note a favorable comparison,

4 note a fair comparison,

7 have no statistics.

Of the 10 men's colleges,

6 note a favorable comparison,

3 note a fair comparison,

1 has no statistics.

Question 7.

Of the 15 women's colleges,

9 answered "no,"

5 emphasize the school record,

1 gave no information.

Of the 10 men's colleges,

1 answered "yes,"

6 answered "no,"

3 emphasize the school record.

Question 8.

Of the 15 women's colleges,

4 state definitely that they want a 4-year preparation,

2 wish greater emphasis on algebra,

7 wish greater emphasis on thoroughness of fundamentals,

1 wishes greater thoroughness in arithmetic,

1 suggests solid geometry and spherical trigonometry in the secondary school,

2 suggest advanced algebra and trigonometry for 4-year students,

3 say "leave analytics and calculus to us."

Of the 10 men's colleges,

3 state definitely that they want a 4-year preparation,

4 wish greater emphasis on algebra,

1 wishes greater emphasis on thoroughness of preparation,

1 suggests solid geometry and spherical trigonometry in the secondary school.

Professor Copeland of Wellesley College writes in part,

> While it is true that at present there are extraordinary openings for students trained in Mathematics and the physical sciences to teach and to do government work connected with the war, it is also true that there have been in the past and are now ever increasing demands for college graduates who have combined economics with mathematics to fill positions with investment houses, banks and actuarial departments of life insurance companies. Among other fields open to mathematics majors are those of architecture, mapping, drafting, engineering, statistics, and various civil service positions. Hence it seems very important to me that students who have mathematical ability should study four units of mathematics in preparatory school. There are many responsible, important, and challenging positions to be filled by such scholars.

The twelve answers which have not been incorporated in the above summary include valuable comments which the committee wishes to mention at this point.

Professor Beatley of Harvard stresses the need for a substantial two years of algebra and one of geometry and a thoroughness in algebra.

B. A. Thresher, Director of Admissions, at the Massachusetts Institute of Technology writes,

> As to suggestions, I don't know whether you can take our experience and needs as typical of colleges in general. I might say, however, that we should advocate some reduction in the time given to so-called Advanced Algebra or college Algebra courses, with an effort to gain greater proficiency in the work normally covered in the first two years of Algebra. In Solid Geometry, we should like the special emphasis made on the derivation and use of formulas for areas and volumes rather than detailed attention given to the proof of theorems, since practice in this latter type of thinking has usually been obtained by the student in his Plane Geometry course. Trigonometry is, of course, essential as a basis for our work, and it has been our experience that many students lack facility in the use and manipulation of trigonometric identities.

Professor Murnaghan, of Johns Hopkins University, echoes this opinion concerning the teaching of solid geometry.

Dean Orme, of Bradford Junior College, suggests the need for students who have not progressed beyond algebra to review J.H.S. Mathematics before entering college.

Professor Carver, of Cornell, notes the lack of thoroughness in algebra training, and the absence of understanding of processes which a student is able to use.

Professor Logsdon, of University of Chicago, says, "We find our students rusty and inaccurate. What to do!"

Professor Flexner, of Cornell University, notes three outstanding deficiencies in otherwise good mathematical preparation: the meaning of O/a, the meaning of a/O and the translation of verbal problems into appropriate mathematical form. Professor Flexner also stresses the importance of the first two years of algebra and one year of plane geometry plus formulas for volumes of rectangular box, sphere, cylinder and cone.

The committee draws the following conclusions:

1. The time when the teacher of mathematics on the secondary level could say that his curriculum was determined by College Entrance requirements is definitely past. The flexible use made of the mathematical section of the S.A.T., and the meager use made of the C.E.B. achievement test by the colleges of liberal arts, certainly leave the teacher of preparatory work to teach the best mathematics he knows in the best way he knows.

2. The capable secondary school student should be urged to study four years of mathematics for two reasons: first, the majority of colleges recognize this preparation by providing sufficient courses to enable the student to continue his study at a suitable level; second, the student may use his mathematics in combination with other knowledge in many fields of endeavor.

3. The teacher of secondary mathematics must be strict in his demands for a

thoroughness of understanding on the part of his students in the fields of elementary algebra and plane geometry, and work for greater efficiency in the use of the techniques acquired in these studies.

The committee wishes to acknowledge the cooperation of the thirty-seven college faculty members who sent replies to the questionnaire. In addition to ordinary academic duties, everyone has had many wartime demands made upon his time. It was, therefore, particularly generous of the professors of mathematics, deans of colleges, and Directors of Boards of Admissions to answer our questionnaire in such detail and to write letters containing valuable information and opinions. These letters will be kept on file with the Chairman of the Mathematics Section of the Private School Association, for the reference of any teachers who may be interested.

The chairman of the committee wishes to extend her thanks to Miss Lena Buckey and Mr. Harry R. Dougherty for their efforts in planning this project and seeing it carried through.

With the viewpoint of the colleges so definitely set before us, the committee believes that the ground has been laid for the work of a committee of mathematics teachers of private schools on content of Junior High School Mathematics courses. Despite all the curricula which has been formulated, there is still more disagreement on this subject than seems necessary. Parents and administrators are at a loss to understand discrepancies between the Junior High School courses in various schools, and students' programs become confused when transferring from school to school. A committee on this subject would be in order.

OFFICIAL NOTICE BY EDWIN W. SCHREIBER, SECRETARY

The National Council of Teachers of Mathematics

As SECRETARY of the National Council of Teachers of Mathematics, I officially announce the annual election of certain officers of the National Council, said election to take place February 26, 1944.

At the Atlantic City Meeting, Feb. 26, 1938, the Nominating Committee, consisting of the two most recent ex-presidents and the secretary as chairman (for this year: H. C. Christofferson, Mary A. Potter, and Edwin W. Schreiber), was instructed to prepare an official ballot naming two eligible candidates for each elective office, reserving a blank space for a third prospective candidate whose name may be written in by the voter. The officers to be elected are: President, 1944–1945, Second Vice-President, 1944–1945, and three Directors, 1944–1946. The official ballot will be sent to members through the mail in January, 1944.

The periods of service of the officers of the National Council, from its organization in February, 1920 to the present time are printed on the following page.

EDWIN W. SCHREIBER, *Secretary*

The National Council of Teachers of Mathematics

Organized 1920—Incorporated 1928

Honorary President

*H. E. Slaught, Chicago, Ill., 1936–1937

Presidents

1. C. M. Austin, Oak Park, Ill., 1920
2. J. H. Minnich, Philadelphia, Pa., 1921–1923
3. Raleigh Schorling, Ann Arbor, Mich., 1924–1925
4. Marie Gugle, Columbus, Ohio, 1926–1927
5. Harry C. Barber, Exeter, N. H., 1928–1929
6. John P. Everett, Kalamazoo, Mich, 1930–1931
7. William Betz, Rochester, N. Y., 1932–1933
8. J. O. Hassler, Norman, Okla., 1934–1935
9. Martha Hildebrandt, Maywood, Ill., 1936–1937
10. H. C. Christofferson, Oxford, Ohio, 1938–1939
11. Mary A. Potter, Racine, Wis., 1940–1941
12. Rolland R. Smith, Springfield, Mass., 1942–1943

Vice-Presidents

1. H. O. Rugg, New York City, 1920
2. E. H. Taylor, Charleston, Ill. 1921
3. Eula Weeks, St. Louis, Mo., 1922
4. Mable Sykes, Chicago, Ill., 1923
5. Florence Bixby, Milwaukee, Wis., 1924
6. Winnie Daley, New Orleans, La., 1925
7. W. W. Hart, Madison, Wis., 1926
8. C. M. Austin, Oak Park, Ill., 1927–1928
9. Mary S. Sabin, Denver, Colo., 1928–1929
10. Hallie S. Poole, Buffalo, N. Y., 1929–1930
11. W. S. Schlauch, New York City, 1930–1931
12. Martha Hildebrandt, Maywood, Ill., 1931–1932
13. Mary A. Potter, Racine, Wis., 1932–1933
14. Ralph Beatley, Cambridge, Mass., 1933–1934
15. Allan R. Congdon, Lincoln, Neb., 1934–1935
16. Florence Brooks Miller, Shaker Heights, Ohio, 1935–1936.
17. *Mary Kelly, Wichita, Kansas, 1936–1937
18. John T. Johnson, Chicago, Ill., 1937–1938
19. Ruth Lane, Iowa City, Iowa, 1938–1939
20. E. R. Breslich, Chicago, 1939–1940
21. F. L. Wren, Nashville, Tenn., 1940–1941
22. R. L. Morton, Athens, Ohio, 1941–1942
23. Dorothy S. Wheeler, Hartford, Conn., 1942–1943
24. Edwin G. Olds, Pittsburgh, Pa., 1943–1944

Secretary-Treasurers

J. A. Foberg, Chicago, Ill., 1920–1922, 1923–1926, 1927, 1928 (Appointed by Board of Directors)

Edwin W. Schreiber, Ann Arbor, Mich., and Macomb, Ill., 1929– (Appointed by the Board of Directors)

Committee on Official Journal

John R. Clark, Editor, 1921–1928
W. D. Reeve, Editor, 1928–
Vera Sanford, 1929–
*H. E. Slaught, 1928–1935
W. S. Schlauch, 1936–

Directors

Marie Gugle, Columbus, Ohio, 1920–1922, 1922, 1928–1930, 1931–1933
Jonathan Rorer, Philadelphia, Pa., 1920–1922
Harry Wheeler, Worcester, Mass., 1920–1921
W. A. Austin, Fresno, Cal., 1920–1921
W. D. Reeve, Minneapolis, Minn., 1920, 1926–1927
W. D. Beck, Iowa City, Iowa, 1920
*Orpha Worden, Detroit, Mich., 1921–1923, 1924–1927
C. M. Austin, Oak Park, Ill., 1921–1923, 1924–1927, 1930–1932, 1940–1942
Gertrude Allen, Oakland, Cal., 1922–1924
W. W. Rankin, Durham, N. C., 1922–1924
Eula Weeks, St. Louis, Mo., 1923–1925
W. C. Eells, Walla Walla, Wash., 1923–1925
*Harry English, Washington, D. C., 1925–1927 1928–1930
Harry C. Barber, Boston, Mass., 1925–1927, 1930–1932, 1933–1935
*Frank C. Touton, Los Angeles, Cal., 1926–1928
Vera Sanford, New York City, 1927–1928
William Betz, Rochester, N. Y., 1927–1929, 1930–1931, 1934–1936, 1937–1939
Walter F. Downey, Boston, Mass., 1928–1929
Edwin W. Schreiber, Ann Arbor, Mich., 1928–1929
Elizabeth Dice, Dallas, Tex., 1928, 1929–1931
J. O. Hassler, Norman, Okla., 1928, 1929–1931, 1933, 1941–1943
John R. Clark, New York City, 1929–1931
Mary S. Sabin, Denver, Colo., 1929–1930, 1931–1933
J. A. Foberg, California, Pa., 1929
C. Louis Thiele, Detroit, Mich., 1931–1933
*Mary Kelly, Wichita, Kan., 1932
John P. Everett, Kalamazoo, Mich., 1932–1934
Elsie P. Johnson, Oak Park, Ill., 1932–1934
Raleigh Schorling, Ann Arbor, Mich., 1932–1934
W. S. Schlauch, New York City, 1933–1935
H. C. Christofferson, Oxford, Ohio, 1934–1936, 1937–1939
Edith Woolsey, Minneapolis, Minn., 1934–1936, 1937–1939
Martha Hildebrandt, Maywood, Ill., 1934–1935
M. L. Hartung, Madison, Wis., 1935–1937, 1938–1940
Mary A. Potter, Racine, Wis., 1935–1937
Rolland R. Smith, Springfield, Mass., 1935–1937, 1938–1940
E. R. Breslich, Chicago, Ill., 1936–1938
L. D. Haertter, Clayton, Mo., 1936–1938
Virgil S. Mallory, Montclair, N. J., 1936–1938, 1939–1941
Kate Bell, Spokane, Wash., 1938–1940, 1941–1943
A. Brown Miller, Cleveland, Ohio, 1939–1941, 1941–1943
Dorothy Wheeler, Hartford, Conn., 1939–1941
Hildegarde Beck, Detroit, Mich., 1940–1942, 1943–1945
H. C. Charlesworth, Denver, Colo., 1940–1942, 1943–1945
L. H. Whitcraft, Muncie, Ind., 1941–1943
A. R. Congdon, Lincoln, Nebr., 1941–1943
Ina E. Holroyd, Manhattan, Kans., 1941–1943
Veryl Schutt, Washington, D. C., 1943–1945

* Deceased.

◆ THE ART OF TEACHING ◆

Another Study of Prognosis in College Algebra

By M. V. MARSHALL

Franklin and Marshall College, Lancaster, Pennsylvania

THE PROBLEM of selecting probable successes and probable failures among the freshmen beginning college algebra is of both academic interest and practical administrative importance. The more accurately it can be done the more effective can such provisions as counselling, differentiated courses, individual instruction, and differentiated time allotments be made.

In the present study one hundred and forty-four freshmen were studied. Three predictive variables were used: the *Cooperative Algebra Test* as a measure of the students' knowledge of algebra at the beginning of the course; the American Council Psychological Examination as a measure of general academic aptitude; and the Q-score on the American Council Psychological Examination as a measure of aptitude for quantitative thinking. These were all administered before the course began. The course followed was identical for all students but sectioning was done on the basis of results from the *Cooperative Algebra Test* into a special high section, three-hour per week sections, and five-hour per week sections. Those with less knowledge of algebra at the beginning, the five-hour per week sections, were given a great deal of individual instruction, coaching and drill. As a measure of success the professor's grades in the course were used. Obviously this admits subjectivity of judgment into the measurement but, until the use of objective testing is much more prevalent among college professors than it is at present, the criterion of success in a course will be the professor's grades.

The relationships between the three predictive criteria and the criterion of success as computed by the Pearson product-moment coefficient of correlation are:

Correlation between algebraic knowledge and the professor's grade: 0.571. Correlation between general intelligence and professor's grade: 0.383. Correlation between mathematical aptitude and professor's grade: 0.375.

It is clear that the first predictive criterion is superior to the other two and that there is little difference in the predictive value of the two latter. As far as they go these results confirm those of a previous study* and support the conclusion that an objective measure of knowledge of algebra is probably the best criterion of success in College Algebra and the most practical basis for sectioning students.

In this study the *Cooperative Algebra Test* showed such a sharp differentiation that, of the 117 students whose scores were above 16, 81.19% made passing marks, and of the 27 students whose scores were below 17, only 14.8% made passing marks.

Partial and Multiple Correlations:

Variables: 1. Professor's grade.
2. Algebraic knowledge.
3. General intelligence.
4. Mathematics aptitude.

$r_{12.34} = 0.452$
$r_{13.24} = 0.0235$
$r_{14.23} = 0.0859$
$R_{1(234)} = 0.5822$

The correlation between the professor's grade and algebraic knowledge, when the effects of general intelligence and specific mathematical aptitude are held constant, is still significant, while the other two coefficients of partial correlation are insignificant. Correlation of the professor's grade with the other three variables combined yields the highest coefficient of all.

* Marshall, M. V., Some Factors Which Influence Success in College Algebra, THE MATHEMATICS TEACHER, April, 1939.

EDITORIALS

Marie Gugle's Retirement

MISS MARIE GUGLE, former president of The National Council of Teachers of Mathematics, formerly Assistant Superintendent of Schools in Columbus, Ohio, and more recently principal of East High School in Columbus, has retired from active work after many years of devoted service to the schools in her home city.

Miss Gugle has made a significant contribution to The National Council of Teachers of Mathematics of which she is a charter member. She was also active in the work of the Central Association of Science and Mathematics Teachers and has associated herself in many ways with groups interested in the improvement of mathematical education. As a teacher and textbook writer she has influenced the teaching of mathematics in the schools throughout the country.

THE MATHEMATICS TEACHER wishes to extend to Miss Gugle best wishes for a long and well deserved period of freedom to do as she wishes with her time. We hope, however, that she will continue her interest in the Council in the days to come.

W. D. R.

What Next?

Now that teachers of mathematics all over the country have access to various syllabi, pamphlets, books and other material intended to be of help to them during the war period, the question that naturally arises is, "How much use will be made of such material?" From the reports that come to this office from various parts of the country one is inclined to think that some teachers have not changed their content or methods of teaching to any appreciable extent. With mathematics in a position of preferment because of war needs and demands it is most important that we not only do all we can to improve the situation while war is being waged, but begin to think about the kind of mathematics that we shall need to teach once the war is won. Here is a chance for The National Council of Teachers of Mathematics to exert itself again.

W. D. R.

The 1944 Yearbook

The 1943 yearbook (the 18th) is still in press, but will be ready soon. It deals with "Multisensory Aids in the Teaching of Mathematics" and should be a most helpful volume.

It is now time to think about the type of yearbook that will be most helpful in 1944 in view of the long list of titles that have already appeared and which have been most helpful to teachers everywhere. The Editor would appreciate it greatly if members of the Council would write him *at once* suggesting a type of yearbook that they think would be most helpful and appropriate for this coming year.

W. D. R.

◆ IN OTHER PERIODICALS ◆

By NATHAN LAZAR

Midwood High School, Brooklyn, New York

The American Mathematical Monthly

May 1943, Vol. 50, No. 5.

1. Heath, R. V., "A Magic Cube with $6n^3$ Cells," pp. 288–291.
2. Cell, J. W., "Mathematics Instruction in Engineering," pp. 303–307.
3. Phillips, H. B., "Applied Mathematics," pp. 307–309.
4. Whitman, E. A., "Some Historical Notes on the Cycloid," pp. 309–315.
5. Bellman, Richard, "A Note on the Divergence of a Series," pp. 318–319.
6. Bibb, S. F., "An Analog of Pascal's Arithmetical Triangle," pp. 319–322.

June–July 1943, Vol. 50, No. 6.

1. Coolidge, J. L., "Three Hundred Years of Mathematics at Harvard," pp. 347–356.
2. Dehn, Max, "Mathematics, 600 B.C.–400 B.C.," pp. 357–360.
3. Macduffee, C. C., "What is a Matrix?" pp. 360–365.
4. Waltz, A. K., "Analogs," pp. 380–381.
5. Aroian, L. A., "A Certain Type of Integral," pp. 382–383.

National Mathematics Magazine

May 1943, Vol. 17, No. 8.

1. "Once More—Mathematics and the Engineer," pp. 330–333.
2. Miller, O. A., "A Sixth Lesson in the History of Mathematics," pp. 341–350.
3. Cox, H. M., "Pre-Study Examinations in Mathematics," pp. 351–359.

School Science and Mathematics

June 1943, Vol. 43, No. 6.

1. Hart, William L., "Short Term and Long Term Effects of the War on the Secondary Curriculum in Mathematics," pp. 499–508.
2. Chandler, Turner C., "The Chicago Course of Study in Arithmetic," pp. 523–533.
3. Nyberg, Joseph A., "Notes from a Mathematics Classroom" pp. 559–562.
4. Barnes, Melvin W., "The Relationship of the Study of Mathematics to Q-scores on the ACE Psychological Examination," pp. 581–582.
5. Ransom, William R., "A Geometrical Meaning for $f''(x)$," pp. 600.

Scripta Mathematica

March 1943, Vol. 9, No. 1.

1. Fraenkel, Abraham Adolf, "Problems and Methods in Modern Mathematics," pp. 5–18.
2. Kasner, Edward and Comenetz, George and Wilkes, John, "The Covering of the Plane by Circles," pp. 19–25.
3. Kasner, Edward, "Note on Non-Apollonian Packing in Space," p. 26.
4. Polachek, Harry, "The Men Behind the Men behind the Guns," pp. 27–32.
5. Ivins, William M., Jr., "A Note on Girard Desargues," pp. 33–48.
6. Grossman, Howard D., "Factorable Trinomials," pp. 59–60.

Miscellaneous

1. Addleston, L. W., "Remotivating Arithmetic Fundamentals in the Junior High School," *High Points*, 25: 65–70, March 1943.
2. De May, A. J., "Rationalizing Fractions," *Instructor*, 52: 13–14+, January, 1943; 52: 23–24+, February, 1943; 52: 21+, March, 1943; 52: 21–22+, April, 1943; 52: 24+, May, 1943.
3. "ESMWT Establishes Qualifying Course in Mathematics for Women and Older Men," *Education for Victory*, 1: 4, April 1, 1943.
4. Farwell, H. W., and Stifler, W. W., "Two Graphical Constructions in Geometric Optics," *American Journal of Physics*, 11: 99–100, April, 1943.
5. Galloway, G. A., "Contribution of Mathematics to the Democratic Values in General Education," *School and Community*, 29: 166–168, April, 1943.
6. Halliday, F. F., "Plea for the Beginner in Number Work," *School (Elementary Edition)*, 31: 695–699, April, 1943.
7. Hanes, E. M., "Numbers Can Be Fun," *Instructor*, 52: 22–23+, May, 1943.
8. Johler, W. W., "Problems in Solid Geometry," *Journal of Education*, 126: 18–20.
9. Lehr, M., "Contribution of Mathematics," *Proceedings, National Association of Principals of Schools for Girls, 1942*, pp. 81–90.
10. Nyberg, J. A., "Geometry, Logic and Social Studies," *Social Studies*, 34: 104–108.
11. Relleke, D., "Mathematics Can Be Fun," *Nebraska Educational Journal*, 23: 113.
12. Sonley, J. A., "Analysis in Mathematics," *School (Secondary Edition)*, 31: 679–682.
13. Tiews, E. M., "If You'll Get the Equation . . . ," *English Journal*, 32: 213–214.
14. Tyler, F. T., "This Proves . . . ," *School (Secondary Edition)*, 31: 674–678.
15. Wakeham, G., "Will High School Mathematics Survive the War?" *School and Society*, 56: 554–555, Dec. 5, 1942.

NEW BOOKS

Abbie A. Morrill, Mabel A. Bessey, John V. Walsh, *Applied Office Practice*, Third Edition, D. C. Heath & Co., Boston, 1942, 368 pp.

Teacher's Manual and Key to above, 1943.

Edward M. Kanzer and William L. Schaaf, *Essentials of Business Arithmetic*, Revised Edition, D. C. Heath & Co., Boston, 1943. 476 pages.

L. E. Moore, *Elementary Avigation*, D. C. Heath & Co., Boston, 1943. 222 pages.

Webster Wells and Walter W. Hart, *Progressive Plane Geometry*, Second Edition, D. C. Heath & Co., Boston, 1943. 390 pages.

Webster Wells and Walter W. Hart, *Progressive Second Algebra*, Second Edition, D. C. Heath & Co., Boston, 1943. 298 pages.

John R. Clark and Rolland R. Smith, *Plane Geometry*, United States Armed Forces Institute by World Book Co., Yonkers, N. Y., 1943. 248 pages.

Frank J. McMackin and Roscoe P. Conkling, *Essential Mathematics*, Ginn and Co., 1943. 372 pages. Price $1.48.

H. F. Baker, *An Introduction to Plane Geometry*, Cambridge University Press, London (Macmillan Co.), 1943. 382 pages. Price $4.00.

Walter W. Hart, *Progressive First Algebra*, D. C. Heath & Co., Boston, 1943. 408 pages.

Clifford Bell and Tracy Y. Thomas, *Essentials of Plane and Spherical Trigonometry*, Henry Holt and Co., New York, 1943. 142 pages. Price $1.80.

John J. Weir, *Elementary Mathematics for the Machine Trades*, McGraw-Hill Book Co., New York, 1943. 193 pages. Price $1.60.

E. J. Knapp, *Basic Physics* For Pilots and Flight Crews, Prentice-Hall Inc., 1943. New York. 118 pages. Price $1.25.

F. Eugene Seymour and Paul James Smith, *Solid Geometry*, The Macmillan Co., 1943. 263 pages. Price $1.60.

Helen M. Walker, *Elementary Statistical Methods*, Henry Holt and Co., 1943. 368 pages. Price $2.75.

Henry A. Perkins, *College Physics*, Prentice-Hall Inc., 1943. 593 pages. Price $4.00.

Donald H. Ballou and Frederick H. Steen, *Plane Trigonometry with Tables*, Ginn and Company. 84 pages. Price $2.00.

Lyman M. Kells, Willis F. Kern, and James R. Bland, *Piloting and Maneuvering of Ships*, McGraw Hill Book Co., 1943. 181 pages. Price $2.00.

E. Justin Hills, *A Course in the Slide Rule and Logarithms*, Ginn and Co., 1943. 108 pages. Price 75¢.

Clayton E. Buell, *Mathematics for the Sheet Metal Worker*, Pitman Publishing Corp., 1943. 199 pages. Price $2.00.

John W. Cell, *Engineering Problems Illustrating Mathematics*, McGraw Hill Book Co., 1943. 172 pages. Price $1.75.

General Motors Corp., *Airplane Power*, Preliminary Printing, 1943.

Frank M. Morgan, *College Algebra*, American Book Company, 1943. 368 pages. Price $2.00.

Guy T. Buswell, William A. Brownell, Lenore John, *Review Arithmetic*, Textbook 1, Ginn and Co., 1943. 173 pages. Price 60 cents.

Guy T. Buswell, William A. Brownell, Lenore John, *Review Arithmetic*, Textbook 2, Ginn and Co., 1943. 215 pages. Price 60 cents.

L. F. Tuleen, G. S. Porter, and A. Houston, *Prepare Yourself* (Physics Laboratory Workbook), Scott, Foresman & Co., 1943. 60 pages. Price 96 cents.

State Department of Education, Tallahassee, Florida, *Mathematics Essentials for the War Effort*. Bulletin No. 40, September, 1942.

Coast Artillery School, *The Coast Artillery School Mathematics* (for the Coast Artillery Officer), Coast Artillery School, Fort Monroe, Virginia, Revised Edition, July, 1942. 48 pages.

Murlan S. Corrington, *Applied Mathematics for Technical Students*, Harper & Bros., 1943. 226 pages.

R. W. Burnham, *Mathematics for Machinists*, John Wiley & Sons, 1943. 247 pages. Price $1.50.

Cornelius H. Siemens, *Aeronautics Workbook*, Ginn and Co., 1943. 168 pages. Price $1.00.

Thurman S. Peterson, *Intermediate Algebra for College Students*, Harper and Bros., 1942. 358 pages.

Clyde E. Love, *Differential and Integral Calculus*, Fourth Edition, The Macmillan Co., 1943. 483 pages. Price $3.25.

Schorling-Clark-Smith, *First Year Algebra*, Preliminary Edition, World Book Company, 1943.

NEWS NOTES

The twenty-sixth summer meeting of the Mathematical Association of America was held at the New Jersey College for Women, Rutgers University, New Brunswick, New Jersey, on Saturday and Sunday, September 11–12, 1943, in conjunction with the summer meeting and colloquium of the American Mathematical Society and the meeting of the Institute of Mathematical Statistics. Three sessions of the Association were held on Saturday beginning at 10 A.M., 2 P.M., and 8 P.M.

Miss Nanette L. Roche, Supervisor of Junior High School Mathematics, Baltimore, Md. was recently married to Mr. James T. Blakiston a Lieutenant Commander in the Navy Air Forces. Mrs. Blakiston is continuing her work in Mathematics.

The new officers of the Maryland Section of the National Council of Teachers of Mathematics are:

Chairman—Anna Meeks, Franklin High School, Reisterston.

Vice-Chairman—Dorothy Taylor, Baltimore City College.

Treasurer—J. Karl Schwartz, Catonsville High School.

California Mathematics Council

In December 1942 at a meeting of County Representatives of the National Council of Teachers of Mathematics held at Stanford University, a state organization of teachers of mathematics was formed. Its purposes are to supplement and extend the work of the National Council, and disseminate the news and progress reports of what is being done in California, as well as to sponsor studies on the improvement of the teaching of mathematics to meet the crisis.

Officers elected for the new Council are as follows:

Mrs. Ruth G. Sumner, President, Oakland High School, Oakland, California.

Dale Carpenter, Vice-President, Curriculum Coordinator, Los Angeles Schools, Los Angeles, California.

Florence Flannagan, Recording Secretary, San Jose State College, San Jose, California.

Harriette Burr, Treasurer, Ventura Junior High School, Ventura, California.

Lucien B. Kinney, Executive Secretary School of Education, Stanford University California.

Emma Hesse, Junior Past President, Claremont Junior High School, Oakland, California.

Advisors: Commander Franz Melendy, 12th Naval District, San Francisco, California; Professor Chester Jaeger, Pomona College, Claremont, California; Mr. Charles C. Grover, Glenview Elementary School, Oakland, California.

Plans were made for regional meetings. The first of these was held in Oakland, at which Miss Edith St. John Eaton, Alameda County Representative, presided. Reports of the Stanford Conference were given by Miss Eaton and Mrs. Sumner. Mr. Edward J. Albrecht, Fremont High School, Oakland, gave a report on the Mathematics he is teaching to Pre-Flight Cadets in Evening School. Miss Edith Mossman of Berkeley High School reported on the Mathematics in training women in war work. Miss Florence Ragle of Oakland Technical High School spoke on Mathematics on the Home Front. Mr. Emory Simpson of Oakland High School described his work in teaching Radio Communications in both day and evening classes, with emphasis on mathematics.

In February a request came from Mrs. Myrtle McHenry, Solano County Representative, to have a meeting in Fairfield. A group of Council officers and members responded, presenting both morning and afternoon sessions. The speakers were Mr. Albrecht, Mr. Lundeen, Miss Ragle, Mr. Simpson, Miss Mossman, and Mrs. Sumner, who was also the presiding officer for the day.

The meeting was well attended and enthusiastic discussion followed. Mrs. Sumner had taken a large collection of the newer books from the Oakland Professional Library so the teachers might know the current literature on the teaching of Mathematics and related topics.

Miss Ethel Spearman requested the same group to present a report to the Central San Joaquin Section of the National Council March 20th. The program held at Fresno State College follows:

F. R. Morris, *Chairman*

9:30 A.M.

Mathematics and the Home Front, Miss

Florence Ragle, Technical High School, Oakland.
Mathematics in the Armed Services, Miss Edith Mossman, Berkeley High School.
Mathematics in Radio, Mr. Emory Simpson, Central Trade, Oakland.

11:00 A.M.
Mathematics and the War Effort, Dr. W. M. Whyburn, University of California at Los Angeles.
Pre-Flight Training, Mrs. Ruth Sumner, Oakland High School.

12:00 M.
Luncheon, Student Union.
Trip to Treasure Island Naval Station, Miss Emma Hesse, University High School, Oakland.
Philosophic Problems in Science, Dr. H. C. Burbridge, Fresno State College.

An Institute on Educational Problems in Wartime was held at the Stanford University School of Education on August 11, 12, 1943.

Plan of the Meetings

Separate institute meetings were held in the morning and afternoon of Wednesday, August 11, and Thursday, August 12, in the following areas:

Institute	*Director*
Administration	John C. Almack
Elementary Education	Paul Hanna
Guidance and Mental Hygiene	Norman Fenton
The Social Studies	I. James Quillen
The Language Arts	Holland Roberts
Science	R. Will Burnett
Mathematics	Lucien B. Kinney

On Wednesday evening, a joint meeting of all institutes was held at 7:45 in the Education Auditorium. The program was as follows:

Education Forum: *The Crucial Problems in Today's Schools*
Chairman: John C. Almack, Professor of Education, Stanford University
From the Standpoint of the State Department of Education: Walter F. Dexter, Superintendent of Public Instruction and Director of Education
From the Standpoint of the City School System: Walter L. Bachrodt, Superintendent of Schools, San Jose
Discussion led by: Curtis Warren, Superintendent of Schools, San Francisco, and R. Will Burnett, Assistant Professor of Education, Stanford University

MATHEMATICS INSTITUTE

Presented by the California Mathematics Council and the Stanford School of Education Workshop in Mathematics
August 11–12, 1943

GENERAL THEME: *Adjustment of Curriculum and Instruction in Mathematics to Modern Requirements.*

Wednesday, 10:00–11:30 A.M.

Topic: *Present-day Needs in Mathematics*
Chairman: Mrs. Ruth Sumner, Oakland High School, President of California Mathematics Council
Discussion
Leaders: Cornelius Siemens, Assistant Professor of Education, University of California
Commander Franz Melendy, United States Navy
James Hoskins, Coordinator, Peninsula Defense Training Center, Palo Alto

Wednesday, 1:30–2:30 P.M.

Interest Group Meetings with Consultants

Wednesday, 2:30–4:00 P.M.

Joint Meeting with Science Institute
Topic: *Pre-Induction Training in Science and Mathematics to Meet Army Needs*
Chairman: Colonel Benjamin Shute, U.S.A. Second Armored Corps
Speaker: Dr. Will Burnett, Assistant Professor of Education, Stanford University, and member of staff on pre-induction training, War Department, Washington, D. C.

Wednesday, 4:00 P.M.

Tea, served by students, School of Education

Wednesday, 7:45 P.M.

General Session

Thursday, 10:00–11:30 A.M.

Topic: *What is the Next Step in Adjusting Mathematics to Emergency Needs?*
Chairman: Dr. Ralph Fields, Assistant Superintendent of Schools, San Jose, California
Discussion
Leaders: Charles Grover, Principal, Glenview Elementary School, Oakland, California
Colonel Benjamin Shute, Second Armored Corps, United States Army
Harriette Burr, Head of Department of Mathematics, Ventura Junior High School
Florence Flanagan, San Jose State College

Thursday, 1:30–2:30 P.M.

Interest Group Meetings with Consultants

Thursday, 2:30–4:00 P.M.

Topic: *Summary of the Institute*
Chairman: Harold Bacon, Associate Professor of Mathematics, Stanford University
Speakers: Commander Franz Melendy, United States Navy
Cornelius Siemens, Assistant Professor of Education, University of California
Lucien Kinney, Associate Professor of Education, Stanford University

Thursday, 4:00 P.M.

Tea and Social Hour

Members of the Institute were invited to inspect the materials collected in the Mathematics Workshop in Room 76, Education Building.

The Winthrop College branch of the National Council of Teachers of Mathematics is placing emphasis upon mathematics in navigation this year. The branch holds regular monthly meetings which usually consist of talks on mathematics, current events, a business session, and a social hour.

The officers for the year 1942–1943 were: President: Rosemary Bryant; Vice-President: Sarah Parks; Secretary and Treasurer: Claire Sims; Faculty Sponsor: Miss Ellen Rasor.

The organization is composed of junior and senior mathematics majors and all staff members. The seniors feel that application of mathematics to problems of navigation not only is a source of interest to them, but is a good preparation for their future teaching.

The source of material for the programs of the year is A. D. Bradley's recently published book, *Mathematics of Air and Marine Navigation.* It has been found convenient to use the material found in one chapter for each meeting. The topics which have been discussed by various members of the organization are:

Shape and size of the Earth
Great and small circles on the Earth
Types of navigation
Measurement of directions and bearings
Plane, parallel, and middle latitude sailing
Position by cross bearings and by two bearings of a single object
Radio navigation
The three-point problem
The triangle of velocities
Interception
Radius of action returning to a fixed base and to a moving base

Among the topics which are to be discussed at the remaining meetings of the school year are spherical trigonometry of the Earth and nautical astronomy, with emphasis on the celestial sphere, right ascension and declination, star maps, astronomical triangle, etc.

The members hope that programs of this type will aid them to enrich high school mathematics courses which are to be offered during and immediately after the war.

The branch occasionally holds joint social meetings with the Archimedians (a local honorary mathematics club). Two such meetings have been held this year. The first was a Christmas party held at the American Legion Hut in December. The second, held in April, was an evening party featuring games and informal dancing. A number of the Army Air Cadets, who are now stationed on the campus, were the honor guests.

ELIZABETH BEAMAN, Reporter

A Mathematics Conference sponsored by The Rocky Mountain Section of the Mathematical Association of America (twenty-seventh annual meeting) of The National Council of Teachers of Mathematics and The Mathematics Section of the Eastern Division of the Colorado Education Association—Theme, Mathematics for War and Peace—was held at the University of Denver, Denver, Colorado, on April 16 and 17, 1943, Hotel Headquarters, Auditorium Hotel, 14th and Stout Streets.

PROGRAM

Friday, April 16

3:00 P.M.—Margery Reed Mayo Memorial Building, Room 38
Presiding: Professor A. W. Recht, University of Denver
On the place of mechanics in the system of sciences and the training of mathematicians for work in applied mechanics (20 minutes)
Dr. Paul Nemenyi, University of Colorado (Introduced by Professor A. J. Kempner)
A method of measuring effectiveness in the teaching of college mathematics (10 minutes)
Professor J. O. Hassler, University of Oklahoma
The integral of $dx/x = \log x$ as a limiting case of the integral of x to the $(n\text{-}1)$th power times $dx = x$ to the nth power divided by n (15 minutes)
Mr. Wm. LeVeque. University of Colorado
On a continuous Stochastic process (20 minutes)
Professor Andrew G. Clark, Colorado State College
On the introduction of coordinates in an affine plane geometry (15 minutes)

Mrs. Margaret S. Matchett, University of Denver
Graphical methods for representation of various types of functional relations (20 minutes)
Professor A. J. Kempner, University of Colorado

6:30 P.M.—Fellowship Banquet. University Park Methodist Church

Presiding: Professor A. W. Recht, University of Denver
Greetings: Chancellor Caleb F. Gates, Jr., University of Denver
Response: Professor A. E. Mallory, Colorado State College of Education
Address: Teaching mathematics effectively for war or peace
Professor J. O. Hassler, University of Oklahoma

Saturday, April 17

9:00 A.M.—Margery Reed Mayo Memorial Building, Room 38
Business session of the Mathematical Association

Section Meetings

9:30 A.M.—Margery Reed Mayo Memorial Building, Room 38
Elementary School-Junior High School section
Presiding: Miss Helen Allphin, Supervisor of Elementary Education, Denver Public Schools
The "What," "Why" and "How" of Mathematics in the Elementary School
Miss Mary Butler, Central School, Denver
Mathematics enters the "Block" in Junior High School (An actual unit will be presented)
Mrs. Isabelle Lody and Mr. F. Allen Murphy, Gove Junior High School, Denver
Discussion

9:30 A.M. Little Theatre
Senior High School-College section
Presiding: Mr. H. W. Charlesworth, East High School, Denver
Mathematics for the war effort
Lt. Col. G. Everett Hill, Professor of Military Science and Tactics, Denver Public Schools
Wartime applications of High School mathematics
Mr. Oscar Marinoff, East High School, Denver
Discussion

10:30 A.M. General Session
Presiding: Mr. Wendell I. Wolf, Denver Public Schools
Panel Discussion
Mr. H. W. Charlesworth, Denver
Professor D. F. Gunder, Colorado State College
Professor A. W. Recht, University of Denver
Address: Mathematics abridged has gone to war
Professor J. O. Hassler, University of Oklahoma

Officers

Rocky Mountain Section of the Mathematical Association of America: A. W. Recht, Chairman; A. E. Mallory, Vice-Chairman; A. J. Lewis, Secretary-Treasurer.

The National Council of the Teachers of Mathematics: President—Rolland Smith, Public Schools, Springfield, Massachusetts; First Vice-President—R. L. Morton, Ohio University, Athens, Ohio; Second Vice-President—E. G. Olds, Carnegie Institute of Technology, Pittsburgh, Pennsylvania; Secretary-Treasurer—Edwin W. Schreiber, Western Illinois State Teachers College, Macomb, Illinois; Regional Member of Board of Directors—H. W. Charlesworth, East High School, Denver.

The Mathematics section of the Eastern Division of the Colorado Education Association; President—Wendell I. Wolf, Denver, Colorado; Vice-President—A. E. Mallory, Greeley, Colorado; Secretary-Treasurer—Mary Doremus, Denver, Colorado.

General Conference Committee

H. W. Charlesworth, Katherine Compton, Mary Doremus (Secretary), D. F. Gunder, A. J. Lewis (Chairman), A. E. Mallory, Margaret McGinley, A. W. Recht, Isabelle Staub, Wendell I. Wolf.

The Metropolitan New York Section of the Mathematical Association of America held its Second Annual Meeting at Brooklyn College, on Saturday, May 8, 1943.

PROGRAM

Morning Session, 9:45 A.M., Room 3129, Boylan Hall
Chairman: Professor F. H. Miller, Cooper Union
Mathematics in Navigation: Lt. Commander Delwyn Hyatt, U.S.N., U. S. Merchant Marine Academy
Some Applications of Mathematical Statistics in the War Effort: Professor Harold Hotelling, Columbia University
Secret Communications: Major Donald D. Millikin, New York University

Afternoon Session, 2:00 P.M., Room 3129, Boylan Hall
General Chairman: Professor Harris F. MacNeish, Brooklyn College
Program Chairman: Dr. Edna Kramer-Lassar, Thomas Jefferson High School
Address of Welcome: President Harry D. Gideonse, Brooklyn College
Pure Mathematics as a War Course: Professor F. J. Murray, Columbia University

Should the Present Practical Trend in Secondary Mathematics be Extended to the College Mathematics Curriculum? Dr. Nathan Lazar, Midwood High School

Should the Related Mathematics Course be the Required Mathematics Course for all Ninth Year Pupils? Mr. Max Peters, New Utrecht High School

Election of Officers for 1943–1944

Officers of the Metropolitan New York Section, 1942–1943; Harris F. MacNeish, Brooklyn College, Chairman; Edna Kramer-Lassar, Thomas Jefferson High School, Vice Chairman; Howard E. Wahlert, New York University, Secretary; Frederic H. Miller, Cooper Union, Treasurer.

The Association of Mathematics Teachers of New Jersey, held its Seventy-seventh Regular Meeting at St. James Methodist Church, New Brunswick, N. J., on May 8, 1943.

PROGRAM

Morning Session

Mrs. Florence Gorgens, presiding, Jefferson High School, Elizabeth

Miss Mary C. Rogers, New Jersey Representative of the National Council of Teachers of Mathematics

Dr. Rolland R. Smith, President National Council of Teachers of Mathematics

Dr. Eugenie C. Hausle, James Monroe High School, Bronx, N. Y., Topic: "War-Time Mathematics in the New York City Schools"

Business Meeting

Luncheon: St. James Methodist Church, 12:30 P.M.

Afternoon Session, New Jersey Forum

Further Adaptations of the Mathematics Curriculum to Provide More Adequately for the Needs of Boys and Girls Today

Moderator: Dr. Frank J. McMackin, Principal, Dickinson High School, Jersey City

Speakers: Dr. Virgil S. Mallory, State Teachers College, Montclair, Report of Washington Conference

Dr. Carl N. Shuster, State Teachers College, Trenton

Report of Curriculum Advisory Committee for the State of New Jersey

Merlin S. Temple, Senior High School, Summit

Max C. Jordon, Hamilton Township High School, Trenton

General Discussion

Officers

President, Florence Gorgens, Jefferson High School, Elizabeth, N. J.

Vice-President, Hubert B. Rinsinger, Davey Junior High School, East Orange, N. J.

Vice-President, D. R. Davis, State Teachers College, Montclair, N. J.

Vice-President, Fred L. Bedford, State Teachers College, Jersey City, N. J.

Secretary-Treasurer, Mary C. Rogers, Roosevelt Junior High School, Westfield, N. J.

Corresponding Secretary, Dorothy Frapwell, Lafayette Junior High School, Elizabeth, N. J.

Recording Secretary, Margaret M. Dunn, Junior High School, Bloomfield, N. J.

Council Members: Harrison E. Webb, Richard Morris, Charles O. Gunther, Virgil S. Mallory, Andrew S. Hegeman, Howard F. Fehr, R. P. Conkling, Sarah Stumpp, J. W. Colliton, Albert E. Meder, Jr., J. Dwight Daugherty, Chester A. Olinger, Foster E. Grossnickle, Leonard Lumb, William S. Tobey, Samuel M. Gordon

Committees

Arrangements: Prof. Richard E. Morris, Prof. Albert E. Meder, Jr.

Program: Miss Mary Rogers, Chairman, Dr. Virgil S. Mallory, Dr. Amanda Loughren, Dr. Carl Shuster, Miss Marion Lukens.

Tickets: Mrs. Dorothy Frapwell.

The Fifth Meeting of the Men's Mathematical Club of Chicago and the Metropolitan Area was held on Friday April 16, 1943 at the Central YMCA in Chicago. John J. Wellmuth, S.J. Chairman of the Department of Philosophy at Loyola University spoke on the topic, "Some Problems Raised for Philosophy by Mathematics" and Francis J. Gerst, S.J. Dean of the Graduate School and head of the department of Mathematics at Loyola spoke on "Image Points in Algebraic Curves."

At their sixth meeting on May 21, 1943, the following program was given:

Topic: "Is There a Change of Emphasis on Mathematics for Engineers?"

Speaker: Doctor Ovid W. Eshbach, Dean, Technological Institute, Northwestern University, Evanston

Topic: "The First Three Years of Coöperative Education at Northwestern"

Speaker: Professor F. G. Seulberger, Chairman, Department of Industrial Relations, Technological Institute, Northwestern University, Evanston

Topic: "The Language of Mathematics as Used in Engineering Drafting"

Speaker: Assistant Professor Arthur S. Hathaway, Technological Institute, Northwestern University, Evanston

The following officers were elected for the year 1943–44:

President—M. D. Oestricher, Francis W. Parker School, Chicago, Ill.

Secretary-Treasurer—Glenn F. Hewitt, Von Steuben High School, Chicago, Ill.

Recording Secretary—W. N. Barczewski, Waukegan Township High School, Waukegan, Ill.

An Institute for Teachers of Mathematics (Grades 7 to 12) was held at Duke University at Durham, N. C. from June 14 to June 26, 1943 under the leadership of Professor W. W. Rankin of Duke University.

The executive committee was as follows: Professor Helen Barton, Woman's College U. N. C.; Professor E. F. Canaday, Meredith College; Miss Bonnie Cone, Charlotte High School; Miss Laura Efird, Raleigh High School; Professor H. F. Munch, University of N. C.; Professor Ruth Stokes, Winthrop College; Professor W. W. Rankin, Duke University.

Mathematics Laboratory

The Mathematics Laboratory is located in the basement of the West Duke Building on the East Campus. *It contains a model library in mathematics for elementary and secondary schools, a large collection of the most recent textbooks, models, instruments, maps, curriculum studies, committee reports, etc.* Teachers attending the institute were requested to bring sample pieces of work done by students—homemade instruments, models, drawings, etc.—and place them on exhibit.

Daily Schedule

(All meetings held on East Campus, West Duke Building)

Unit I

Mathematics in Aeronautics

Leader, Dr. Arthur S. Otis, Yonkers-on-Hudson, New York, Consultant for World Book Company.

Monday, June 14. *Professor J. J. Gergen, Presiding, Chairman, Mathematics Department, Duke University.*

4:00–5:30 p.m. "Mathematics of Aviation," Dr. Arthur S. Otis.

8:30 p.m. *Professor E. F. Canaday, Meredith College, Presiding.*

"Science in Aeronautics," Dr. Arthur S. Otis.

Tuesday, June 15.

9:30–11:00 a.m. Mathematics Laboratory, West Duke Building.

11:30–12:30 p.m. Curriculum Study (Outside Helps), Professor W. W. Rankin.

4:00–5:30 p.m. *Professor H. F. Munch, University of North Carolina, Presiding.*

"Aerodynamics," Dr. Arthur S. Otis.

6:00 p.m. Supper meeting (informal), *Miss Bonnie Cone, Presiding, Chairman of Mathematics Section of North Carolina Education Association, Charlotte High School.*

Address: Dr. Clyde A. Erwin, Superintendent of State Department of Public Instruction, Raleigh, North Carolina.

8:30 p.m. *Professor Ruth Stokes, Winthrop College, Presiding.*

"Learning to Fly" (movie), Dr. Arthur S. Otis.

Wednesday, June 16.

9:30–11:00 a.m. Mathematics Laboratory.

11:30–12:30 p.m. Curriculum Study (Statistics in High School), Professor Douglas E. Scates, Duke University.

4:00–5:30 p.m. *Mrs. Maud N. Earle, Greenville, South Carolina, High School, Presiding.*

"Navigation," Dr. Arthur S. Otis.

8:30 p.m. *Mr. W. C. Lord, Woodbury Forest School, Presiding.*

"Meteorology," Dr. Arthur S. Otis.

Unit II

Mathematics in Engineering

Leader, Professor J. W. Seeley, College of Engineering, Duke University, Teacher of Electrical Engineering.

Thursday, June 17.

9:30–11:00 a.m. Mathematics Laboratory.

11:30–12:30 p.m. Curriculum Study (Mechanical Aids).

4:00–5:30 p.m. *Dean W. H. Hall, College of Engineering, Duke University, Presiding.*

"Why Mathematics in Engineering?" Professor J. W. Seeley.

8:30 p.m. *Mr. B. L. DeBruyne, Durham High School, Presiding.*

"Riding on Mathematics," Professor F. J. Reed College of Engineering, Duke University.

Friday, June 18.

9:30–11:30 a.m. Mathematics Laboratory.

11:30–12:30 p.m. Curriculum Study (Everyday Uses of Mathematics).

4:00–5:30 p.m. *Miss Margaret Ricks, Rocky Mount High School, Presiding.*

"Practical Uses of Complex Numbers," Professor J. W. Seeley.

8:30 P.M. *Miss Olive Smith, Winston-Salem High School, Presiding.*

"Applications of Secondary Mathematics to War Problems," Professor C. R. Vail, College of Engineering, Duke University.

SATURDAY, JUNE 19. *Professor H. F. Munch, University of North Carolina, Presiding.*

9:30–11:00 A.M. "Building Machines with Formula, Graph, and Table," Professor F. J. Reed.

11:00–12:00 NOON "Difficult Situations Made Simple," Professor C. R. Vail, College of Engineering, Duke University.

7:00 P.M. Movie (Quadrangle). Dance (Gymnasium).

SUNDAY, JUNE 20.

5:00 P.M. Tea, Dr. Betz, Miss Cone, Professor Stokes, Professor Barton, Professor Seeley, Professor Dressel, at Professor Rankin's Home, 1011 Gloria Ave.

UNIT III

ARITHMETIC IN THE HIGH SCHOOL

Leader, Dr. William Betz, Rochester, New York, Mathematics Specialist.

MONDAY, JUNE 21.

9:30–11:00 A.M. Mathematics Laboratory.

11:30–12:30 P.M. Curriculum Study (Applications).

4:00–5:30 P.M. *Miss Laura Efird, Raleigh High School, Presiding.*

"The Present Crisis in Arithmetic, Underlying Causes and First Steps toward Necessary Improvement," Dr. William Betz.

8:30 P.M. *Professor W. A. Brownell, Duke University, Presiding.*

"Planning a Program for Rebuilding of Arithmetic," Dr. William Betz.

TUESDAY, JUNE 22.

9:30–11:00 A.M. Mathematics Laboratory.

11:30–12:30 P.M. Curriculum Study (Problem Material)

4:00–5:30 P.M. *Professor Helen Barton, Woman's College of the University of North Carolina, Presiding.*

"An Outline of the Basic Computational Skills of Elementary Arithmetic, with a Discussion of Class Room Methods," Dr. William Betz.

WEDNESDAY, JUNE 23.

9:30–11:00 A.M. Mathematics Laboratory.

11:30–12:30 P.M. Curriculum Study (Use of Tables).

4:00–5:30 P.M. *Mrs. Hannah Stack, Fayetteville Elementary School, Presiding.*

"The Arithmetic of Percentage and Its Applications," Dr. William Betz.

8:30 P.M. *Miss Grace Long, Central High School, Washington, District of Columbia, Presiding.*

"Social Backgrounds; Problem Solving; Visual Aids; and Class Room Devices," Dr. William Betz.

UNIT IV

AIR NAVIGATION

Leader, Professor F. G. Dressel, Mathematics Department, Duke University, Teacher of Navigation.

THURSDAY, JUNE 14.

9:30–11:00 A.M. Mathematics Laboratory.

11:30–12:30 P.M. Curriculum Study (Arithmetic in the Service).

4:00–5:30 P.M. *Mrs. Rosalie Elliott, Durham High School, Presiding.*

"Arithmetic and Algebra Used in Navigation," Professor F. G. Dressel.

8:30 P.M. *Professor E. T. Browne, University of North Carolina, Presiding.*

"Graphical Solutions in Navigation Problems," Professor F. G. Dressel.

FRIDAY, JUNE 25.

9:30–11:00 A.M. Mathematical Laboratory.

11:30–12:30 P.M. Curriculum Study (Scale Drawing).

4:00–5:30 P.M. *Professor K. B. Patterson, Duke University, Presiding.*

"Instruments Used in Navigation," Professor F. G. Dressel.

8:30 P.M. *Professor C. G. Mumford, State College, Raleigh, North Carolina, Presiding.*

"Maps and Their Use in Navigation," Professor F. G. Dressel.

SATURDAY, JUNE 26.

9:30–10:30 A.M. Curriculum Study (Related Subjects).

10:30–12:00 NOON. *Professor J. M. Thomas, Duke University, Presiding.*

"Planning a Flight from Maps," Professor F. G. Dressel.